

Deccan Education Society's
FERGUSON COLLEGE, PUNE
(AUTONOMOUS)

SYLLABUS UNDER AUTONOMY

M.Sc. - I
Environmental Science

SEMESTER – I

Academic Year 2016-2017

Deccan Education Society's
FERGUSSON COLLEGE, PUNE

**Scheme of Course Structure with Course Code (Faculty of Science)
Post-graduate**

	M.Sc. Environmental Science Course Structure for 2016-17 Semester I	No of Credits
EVS4101	Environmental Biology	4
EVS4102	Environmental Chemistry	4
EVS4103	Environmental Geoscience	4
EVS4104	Environmental Statistics	4
EVS4105	Environmental Science Practical - I	4
EVS4106	Environmental Science Practical - II	4
EVS4107	Research Methodology	1
	Semester II	
EVS4201	Environmental Pollution and Control I: Water and Soil	4
EVS4202	Biodiversity, Forestry and Conservation	4
EVS4203	Atmospheric Sciences	4
EVS4204	Water and Wastewater Technology	4
EVS4205	Environmental Science Practical - III	4
EVS4206	Environmental Science Practical - IV	4
EVS4207	Research Methodology	1

**Deccan Education Society's
Fergusson College (Autonomous), Pune
Faculty of Science
Post Graduate Extra Credits**

Semester	Course Code	Title of the Course	No. of Credits
I	XHR0001	Human Rights - I	1
	XCS0002	Introduction to Cyber Security - I / Information Security - I	1
	XSD0003	Skill Development - I	1
II	XHR0004	Human Rights - II	1
	XCS0005	Introduction to Cyber Security - II / Information Security - II	1
	XSD0006	Skill Development - II	1

	Deccan Education Society's Fergusson College, Pune	
	EVS4101: Environmental Biology (Credits 4)	
Units	Contents	Sessions
1. Concepts and Scope	<ul style="list-style-type: none"> • Biosphere as an ecosystem, its ecological processes and life support systems. • Anthropogenic impact on the biosphere and its life support systems • (Including Flora, Fauna, soil, climate, and atmosphere, terrestrial and aquatic ecosystems). • Role of biological processes in remedial measures and restoration. 	6
2. Fundamental Concepts of Ecology	<ul style="list-style-type: none"> • Ecology: definition, development and scope. Ecology as an experimental science • Basic principles and laws of Ecology • Ecosystems: concept, components and functioning. • Influence of environmental factors (including temperature, light, moisture, soil, nutrients) on organisms and their adaptations in response to them. 	8
3. Population Ecology	(a) Population Ecology: <ul style="list-style-type: none"> • Population Characteristics • Population Dynamics: Patterns of survival, age distribution, dispersal and rates of change. • Attributes of K- selected and r-selected species. • Population Growth 	8
4. Community Ecology	b) Community Ecology: <ul style="list-style-type: none"> • Community Characteristics • Competition, Exploitation (including herbivore, predation, parasitism), Mutualism (including commensalism, cooperation, symbiosis) • Food webs and concepts of niche and keystone species. • Succession, development, climax and stability of 	8
5. Terrestrial Biomes	<ul style="list-style-type: none"> • Climatic and edaphic factors of terrestrial biomes. Heinrich Walter's Biome Climate Diagrams • Classification of land biomes with their soil, climate and vegetation characteristics. Their natural history, wildlife, geography and human influences. • Mountain Biome: Replication of latitudinal changes in the altitudes of high mountains. • Terrestrial biomes, ecosystem diversity, forest and vegetation types in India. 	8
6. Freshwater and Marine	<ul style="list-style-type: none"> • Challenges and adaptations of life in 	8

Biomes	<p>aquatic biomes (freshwater: still and flowing, marine).</p> <ul style="list-style-type: none"> • Freshwater Biomes (Rivers, streams, lakes, ponds) and their natural history • Marine Biomes (including mangroves, coral islands, kelp forests, saltwater marshes, seashores, estuaries) and their natural history • Wetlands – definitions, types, ecological functions and resources. 	
7. Environmental Microbiology	<ul style="list-style-type: none"> • Classification of microbes and their metabolism and ecology • Micro-organisms and their association with man, animals and plants. • Role of microbes in bio-remedial processes, ecological restoration and other environmental applications. • Environmental factors affecting microbes, their cultivation and growth 	4
8. Ethnobiology	<ul style="list-style-type: none"> • Definition, Concept, History and Scope • Stages of Ethnobiology • Stage 1. Ethnoecology • Stage 2. TEK: Traditional Ecological Knowledge • Stage 3. Indigenous Intellectual Property and Rights • Moving toward more Local Participation • Ethnobiology as Future 	8
References	<ul style="list-style-type: none"> • Microbes, Man and Animals: The Natural History of Microbial Interactions: Linton, A. H. and Burns, R.G. (1982) John Wiley and Sons. • Elements of Microbiology: Pelczar, M.J. and Chan ECS, 1981 McGraw Hill. • General Microbiology: Stainer, R.Y., Adelberg, E.A. and Ingraham, J.L. 1977. Macmillan Press. • Microbial Methods for Environmental Biotechnology: Grainer, J.M. and Lynch, J.M. 1984. Academic Press. • Microbiological Methods for Environmental Scientists and Engineers: Gaudy, A.F. and Gaudy, E.T. 1980, McGraw Hill. • Fundamentals of Ecology: E. P. Odum • Modern concepts in Ecology: H. D. Kumar • Inorganic Chemistry of Earth: Fergusson J. E. • Introduction to Geochemistry: Krauskopf K. B. • Environmental Chemistry: Raiswell • Environmental Chemistry: S. E. Manahan 	

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Department of Environmental Science**

EVS4102: Environmental Chemistry (Credits 4)

No	Chapter Title	Content	No of Lectures
1	Environmental Analytical Chemistry Part A:	Principle, Instrumentation and Environmental Applications: <ul style="list-style-type: none"> • Gravimetric analysis • Spectrophotometry • Atomic absorption spectroscopy • Flame photometry • Nephelometry and turbidometry • Polarography 	8
2	Environmental Analytical Chemistry Part B:	Principle, Instrumentation and Environmental Applications <ul style="list-style-type: none"> • Gas chromatography • High performance liquid chromatography • Ion exchange chromatography • X-ray fluorescence, x-ray diffraction, x-ray absorption • Neutron activation analysis • Isotope dilution analysis 	8
3	Chemistry of Soil and Water:	<ul style="list-style-type: none"> • Soil composition: minerals, organic matter, moisture • Soil reactions: acid-base and ion exchange reaction • Essential elements: macro and micro elements • Structure and properties of water, solubility, acid-base reactions in aqueous systems, • Redox reactions, chemical speciation 	6
4	Surfactants and Synthetic polymers:	a) Synthetic Polymers <ul style="list-style-type: none"> • Need ,classification, characteristics, • Environmental effects: occupational hazards ,heath effects, air, land, marine pollution • Abatement processes: Microbial decomposition, polymer decay, photosensitive additives and alternatives for synthetic polymers. b) Surfactants and Detergents: <ul style="list-style-type: none"> • Need, classification, characteristics and composition. • Environmental Impact and toxicity of Soaps and detergents • Abatement processes: Microbial decomposition treatment and other treatment methods, Modified detergents and alternatives. 	8

5	Chemical Pesticides and Hydrocarbons:	<p>a)Chemical Pesticides :</p> <ul style="list-style-type: none"> • Classification • Environmental degradation, • Pollution due to pesticides and DDT problems <p>b)Hydrocarbons:</p> <ul style="list-style-type: none"> • Classification and sources of hydrocarbons • Environmental effects of hydrocarbons • Environmental degradation and abatement of hydrocarbons 	8
6	Polychlorinated Biphenyls and Metals In Environment:	<p>a)Polychlorinated Biphenyls:</p> <ul style="list-style-type: none"> • Need and uses of PCB's. • Fate of PCB's in environment. • Environmental Effects and Abatement procedures for PCB's pollution. <p>b)Heavy metals:</p> <ul style="list-style-type: none"> • Physical and chemical properties, behavior, human exposure, absorption, influence of Arsenic, lead and mercury on ecosystem. • Biomagnifications of metals in environment. 	8
7	Destruction of Some Hazardous Substances:	<ul style="list-style-type: none"> • Definition, characterization, UN classification • Destruction techniques, safety considerations, mutagenicity assays. • Destruction of acid halides and anhydrides, alkali metals • Destruction of cyanides and cyanogens bromides, • Destruction of chromium, aflotoxins 	8
8	Green Chemistry:	<ul style="list-style-type: none"> • Introduction: Need and Goals of Green Chemistry • Principles of Green Chemistry • Tools of Green Chemistry: Green Starting Materials, Green Reagent, Green Chemical Products etc • Green Chemistry and Sustainability • Zero Waste Technologies 	6

References:

- 1) Instrumental Methods of Analysis by B. Sivasankar, Oxford University Press
- 2) Environmental Chemistry by H. Kaur, Pragati Prakashan
- 3) Textbook of Environmental Chemistry by Balram Pani, IK International Publishing House Delhi
- 4) Fundamental Concepts of Environmental Chemistry by G. S. Sodhi, Narosa Publishing House
- 5) Environmental Chemistry - A. K. Dey New Age International publishers
- 6) Destruction of hazardous chemicals - G. Lunn, E. B.Sandome
- 7) Hazardous substances in chemical lab - G. D. MuMivir

**Deccan Education Society's
Fergusson College, Pune
Department of Environmental Science**

EVS4103 Environmental Geoscience (Credits 4)

Chapter No.	Chapter Title	Content	No of Lectures
1	Structure of the Earth	<ul style="list-style-type: none"> • Origin of earth • Earths facts • Structure of earth • Composition of Earth. • Earth's material: Rocks • Earth's material: Minerals 	6
2	Dynamics and structure of the Earth	<ul style="list-style-type: none"> • geological time scale, • Earthquakes, • volcanoes, • Continental drift, • sea floor spreading and • plate tectonics 	8
3	Earth surfaces processes and landforms	<ul style="list-style-type: none"> • Weathering and erosion, • Mass wasting. • Geomorphology of fluvial tracts, • arid zones, coastal regions, • Karst landscapes and glaciated regions • Cycle of erosion: Davis and Penck. 	8
4	Land use Planning:	<ul style="list-style-type: none"> • Soil genesis, factors, • soil profile, • soil classification soil fertility, • Land use and Soil surveys, • Land capability classification • Land use planning and sustainable development 	8
5	Hydrology	<ul style="list-style-type: none"> • The Hydrologic Cycle • The Hydrologic Budget., • Drainage basins. • Catchment hydrology – precipitation, infiltration, • Evapo-transpiration and runoff, • Surface water and groundwater (aquifers) 	8

6	Oceanography	<ul style="list-style-type: none"> • Ocean basins and physical structure of the ocean floor. • Properties of sea water, waves and tides, • Ocean Currents, • El Niño and Southern Oscillation, • Thermohaline circulation and the global conveyor belt, • Sea level changes. 	8
7	Natural hazards and disaster (A)	<ul style="list-style-type: none"> • Concepts; Landslides and slope failures, • earthquakes, • river and coastal erosion, • Tsunami, • Desertification, • Water logging, salinization and soil degradation. 	8
8	Natural hazards and disaster (B)	<ul style="list-style-type: none"> • Atmospheric disturbances: Thunderstorms, • Cyclones, lightening, • Flood and drought. • Impact of anthropogenic activities such as urbanization, • Mining, river-valley projects, • Excess withdrawal of ground water, etc 	6

Reference Books:

- Lutgens F. K., Tarbuck, E. J. and Tasa, D. 2008. Essentials of Geology, Prentice Hall Publishers.
- Bell F. G., 1998. Environmental geology: principles and practice. Blackwell Sc.. Oxford.
- Thurman, H.V. and Trujillo, A.P., 2004, Introductory Oceanography, Prentice Hall.
- Randolph, J. 2004 Environmental land use planning and management, Island Press, Washington.
- Strahler, A.H and Strahler A.N (2002): Modern Physical Geography, John Wiley and Sons.
- Kale, V. S. and Gupta, A. 2001. Introduction to Geomorphology, Orient Longman, Calcutta.
- Chamley, H. and Chamley, H. 2003. Geosciences, Environment and Man Elsevier Science & Technology.
- Savindra Singh (2002): Geomorphology, Prayag Pustak Bhawan, Allahabad.

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EVS4104 : Environmental Statistics (Credits 4)

Sr. No.	Title of Chapter	Topic details	Lecture
1	Foundation of environmental statistics	Concept of Population, Sample, variable, parameters, types of data, screening and representation of data, Frequency distribution and their properties, histogram, frequency polygon. Random variable and parameters of interest. Concepts of statistical inference, Types of random sampling for selection of sampling units for making observations.	10
2	Measure of central tendency and Measure of Dispersion	Measure of central tendency: Mean, Median and Mode. Measure of Dispersion: Range, Variance, standard deviation and co-efficient of variation. Presentation of data: Summary statistics and graphical methods.	10
3	Probability and probability functions	Distribution models: Normal distribution and its properties. Binomial Distribution Poisson Distribution. Calculation probabilities of different events	10
4	Prediction models, Correlation and Regression	Linear and non- linear regression models, fitting a regression line and parabolic curve, estimating regression coefficients. Calculation of fitted values and residuals.	10
5	Test of Hypothesis	Concepts of Hypothesis testing. Introduction to small sample and large sample test. Chi- squared test: Goodness of fit, Independence of attributes Applications of t test, Z test, one way & two way ANOVA Concept & applications of PCA	10
6	Mathematical models for Environmental studies	Mathematical models: Exponential, logistic models for population growth, Lotka-Volterra Prey and predator model, box model, Gaussian plume, point source stream model Leslie's matrix model.	10

Reference books:

- Barnett Vic (2004) Environmental Statistics: methods and applications.
- Ott, Wayne R. (1995) Environmental Statistics and data analysis.
- Zar, Jerrold H. (1997) Biostatistical Analysis. Prentice Hall (India)
- Nychka, Douglas and Piegorsch Walter W (1998) Case studies in Environmental Statistics.
- Manly Bryan F.J. (2001) Statistics for Environmental Science and Management.
- Walpole R. and Myem R. (1993) Statistics for engineers and scientists.

EVS4105: ENVIRONMENTAL SCIENCE PRACTICAL - I

(4 Credits)

Practicals based on Environmental Biology

1. Visit to a sacred grove/Forest / Grassland / Marine ecosystem to assess its biodiversity.
2. Vegetation studies by line and belt transects and quadrates.
3. Estimating frequency, Density and Abundance of species from Forest/Grassland area.
4. Calculation of Shannon and Simpson's Index for community comparison.
5. Study of wetland (source region visit) and its vegetation and seasonal bird diversity using e-Bird web portal.
6. Methods used for sterilization and media preparation for microbial culture.
7. Isolation and culturing of microbes from soil / water samples,
8. Classification of Bacteria by Gram Staining method.

Practicals based on Environmental Chemistry

1. Estimation of sulfates by Turbidometry from given water sample.
2. Estimation of Na/K (alkali metals) from water/soil by Flame-photometry.
3. Estimation of Alkalinity from the given water sample.
4. Estimation of phosphate from given water sample.
5. Estimation of hardness from given water sample.
6. Determine of pH and Conductivity of Water sample.
7. Visit to instrumentation laboratory.
8. Estimation of chlorides from water samples
9. Estimation of chromium form given water sample
10. Estimation of acidity of the given water samples

EVS4106: ENVIRONMENTAL SCIENCE PRACTICAL - II

(4 Credits)

Practicals based on Geosciences

1. Identification of Rocks.
2. Identification of Minerals.
3. Mapping of Hazard zones in India – Earthquake mapping
4. Mapping of Hazard zones in India – Floods/ Landslides mapping
5. Visit to Geological Survey of India/ observation of weathered landforms.
6. To find out slope/gradient, relative relief and slope angle from given Toposheet.
7. To measure length, perimeter and area, slope and aspect of river / water body.
8. To draw longitudinal profile of stream/ river or water body

Practicals based on Environmental Statistics

1. Graphical data representation by Histogram and frequency polygon.
2. Calculating measures of central tendency for the given data.
3. Calculating variance, standard deviation and coefficient of variation for given data.
4. Computing correlation coefficient and testing its significance.
5. Computing simple linear regression. Plotting scatter diagram and regression line.
6. Comparison between means of two independent samples. Paired t-test
7. Problems based on Analysis of variance: one way and two- way classification
8. Introduction to Software used in Environmental data analysis.

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SYLLABUS UNDER AUTONOMY

M.Sc. - I
Environmental Science

SEMESTER – II

Academic Year 2016-2017

Deccan Education Society's
Fergusson College, Pune
Department of Environmental Science

EVS4201:Environmental Pollution and Control I: Water and Soil (Credits 4)

No	Chapter Title	Content	No of Lectures
1	Water quality Monitoring and Standards	<ul style="list-style-type: none"> • Water Quality parameters: Physical, Chemical and Biological • Objectives of water quality parameters • Selection of sampling location, sampling frequency • Sampling methods: Grab , Composite, Integrated • Collection and Preservation of water sample. • Methods involved in estimation of parameter for pollution levels 	6
2	Fresh water Pollution:	<ul style="list-style-type: none"> • Types and sources of water pollution • pollutants responsible for water pollution: <ul style="list-style-type: none"> ➤ Organic and Biological Pollutants ➤ Heavy metals and radioactive pollutants ➤ Pesticides and detergents. ➤ indicators of water quality • Consequences of water pollution: Effects on health, on biosphere and on economy • Eutrophication: Definition, Limnology of lake, causes and process of eutrophication consequences and control ,Case studies. • Preventive and control measures 	8
3	Ground Water Pollution:	<ul style="list-style-type: none"> • Exploitation of ground water resource, Land subsidence, Sea water intrusion. • Groundwater quality in different provinces of India: problems of Arsenic, nitrate and Fluoride with case studies. • Ground water development in urban area: Artificial recharge and induced infiltration 	8
4	Marine Pollution:	<ul style="list-style-type: none"> • Types and sources: domestic waste, industrial, hazardous waste dumping, shipping transportation etc. • Ballast water and its role in marine Pollution • Disposal of sewage and wash water from MV cargo and ships • Pollution due to off shore drilling, deep mining and oil extraction, oil spills –case studies. • Fishing Activities and marine pollution. • Consequences: Ocean Hypoxia, Harmful Algae Bloom, effect on coral reefs, Metal toxicity –case studies e.g. Minamata tragedy 	8

5	Soil Pollution	<ul style="list-style-type: none"> • Types, sources and consequences of pollutants • Sampling methods and physiochemical and biological parameters of soil • Indicators of soil fertility and quality • Environmental perturbations of the use of agrochemicals. • Soil degradation and wasteland development • Soils with specific problems 	6
6	Pollutants and Soil Environment	<ul style="list-style-type: none"> • Soil pollutants due to industrial environment • Characteristics of pollutants and extraction techniques • Heavy metal speciation • Contaminants transport processes, • Biological transformation of heavy metals • Soil chemistry and reactions of pollutants 	8
7	Soil Pollution Management and Guidelines:	<ul style="list-style-type: none"> • Sanitation techniques in soil pollution management • Risk assessment of contaminated areas • Valorisation of wastes and control of soil pollution • Guidelines on disposal of sewage and effluents • Industrial solid wastes disposal: fly ash, lime sludge, heavy metals, toxic organic compounds etc. • Policies to protect soils: National and international efforts • Importance of soil mapping, use of remote sensing and GIS in soil management 	8
8	Remediation of Soil Pollution	<ul style="list-style-type: none"> • Environmental restoration of degraded areas • Technosols and soil restoration techniques • Use of fly ash in soil remediation • Dumping overburden remediation • Mine tailings restoration • Bioremediation of soils • Development and application of new remediation technologies with case studies 	8

Reference Books

- Environmental Chemistry, B. K. Sharma
- *Handbook of Methods in Environmental studies* (Vol.1 and 2), ABD Publishers, Jaipur, Maiti S.K.
- Environmental Chemistry and Pollution Control, S. S. Dara
- Environmental Pollution, N. Manivasakam
- Environmental Chemistry, A. K. De
- Paul Nathanail C. and Paul Bardos R., Reclamation of Contaminated Land, John Wiley & Sons Limited, 2004.
- William J. Deutsch, Groundwater Geochemistry: Fundamentals and Applications to Contamination, Lewis Publishers, 1997.
- Environmental Science, S. C. Santra

**Deccan Education Society's
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EVS4202: Biodiversity, Forestry and Conservation (Credits 4)

Units	Contents	Sessions
Biodiversity: Concept and Scope	<ul style="list-style-type: none"> • Concept of biodiversity • Types of Biodiversity • Climatic Zones and Biodiversity • Biodiversity as a natural resource • Indian Biodiversity • Vegetational Zones • Zones of Faunal distribution • Major protected areas & their importance • Global Biodiversity • Major Biodiversity areas of the world • Biodiversity Hot Spots 	6
Inventory of Bio – Resources: Global And National	<ul style="list-style-type: none"> • An inventory of Global and Indian biological resources and their present and potential uses. • Magnitude and distribution of Biodiversity (global and Indian) and its characterization. • Rapid assessment of biodiversity and its valuation; skills, trained personnel and resources needed for the task. • Evaluating nature, scale and intensity of the threats to biodiversity. • Developing measures for conservation of biodiversity and approaches to its sustainable utilization. 	6
Plant Resources	<ul style="list-style-type: none"> • Role of plants in natural ecosystems and life support systems (terrestrial, freshwater and marine) • Importance of traditional cultivars and wild species in agriculture • Role of plants in modern and traditional medicine • Value of plants in scientific research and technological inventions • Plants in modern lifestyle and economy • Approaches to conservation of plants (<i>in situ</i> and <i>ex situ</i>) 	8
Animal and Microbial Resources	<ul style="list-style-type: none"> • Role of animals in conservation of natural ecosystems • Role of wild and domesticated gene-pool in human nutrition • Importance of wild species (terrestrial and marine) in medicine • Animals in modern society and economy • Importance of wild species in scientific research and inventions • Value of microbes in medicinal, scientific and technological research, solutions and inventions. 	8
Local Communities	<ul style="list-style-type: none"> • Community conserved areas in India 	8

and Conservation	<ul style="list-style-type: none"> • Origin and Classification • Benefits to communities • Threats and examples of different ecosystems 	
Tribal Communities, Traditional knowledge and conservation	<ul style="list-style-type: none"> • Tribal Communities (hunter-gatherer) in India • Tribal's traditions, beliefs and approach towards natural resources • Traditional knowledge: examples of plant and animal resource • Current Status: Biodiversity, government policies and tribal communities • Need of involving tribal communities in conservation of biodiversity 	8
Conservation Action at International, National and Local Levels	<ul style="list-style-type: none"> • International conventions and treaties for conservation of bio-resources • (including WCS, CBD, CITES, IPCC, Ramsar Convention, UNCLOS, Montreal Convention and others) • National Laws, policies and action plans for conservation of forests, wildlife, biodiversity, marine resources as well as for people's participation in conservation efforts. • Role of NGOs in conservation of bio-resources and people's participation in such efforts at global, national and grassroots level. • Environmental education at academic and non-formal levels • Role of youth in conservation education and action • Participation in conservation issues and action at national and local levels • Generating, sustaining and implementing conservation action at grassroots levels (eg resource conservation, waste disposal, conservation of wildlife in populated and protected landscapes) 	8
Forestry	<ul style="list-style-type: none"> • Forests and Forestry: Forest types of the world. Champion and Seth's Forest Types of India. Forest diversity of Oriental Region. • Forest Management: Working plans in forestry. Forests Departments and their structure. Conservation and protection of natural forests. Nursery, seed stock and forest plantation. • Community participation in forestry: Joint forest management. Social forestry. Eco-development. Habitat management in wastelands for forestry and national resources conservation. • Traditional knowledge and management practices: Medicinal plants in forestry. Rare and endangered forest species. Future sciences in forestry applications. 	8

References

	<ul style="list-style-type: none"> • Medicinal Plants of India's Hotspots. Daya Publishing House, New Delhi. 	
	<ul style="list-style-type: none"> • Gary K Meffe and Ronald Carroll C (1994) Principles of Conservation Biology. Sinauer Associates Inc., Massachusetts. 	
	<ul style="list-style-type: none"> • Groombridge B (Ed.) (1992) Global Biodiversity Status of the Earths Living Resources. Chapman & Hall, London. 	
	<ul style="list-style-type: none"> • IUCN (1992) Global Biodiversity and Strategy. 	
	<ul style="list-style-type: none"> • Sharma PD (2000) Ecology and Environment. Rastogi Publications, Meerut, India. 	
	<ul style="list-style-type: none"> • Singh MP, Singh BS and Soma S. Dey (2004) Conservation of Biodiversity and 	
	<ul style="list-style-type: none"> • Natural Resources. Daya Publishing House, New Delhi. 	
	<ul style="list-style-type: none"> • Virchow D (1998) Conservation and Genetic Resources, Springer-Verlag, Berlin. 	
	<ul style="list-style-type: none"> • Singh B, Social Forestry for Rural Development, Anmol Publishers, New Delhi, (1992). 	
	<ul style="list-style-type: none"> • Murthy J.V.S., Watershed Management in India, (1994). 	
	<ul style="list-style-type: none"> • Raymond F Dasmann, Environmental Conservation, John Wiley (1984). 	
	<ul style="list-style-type: none"> • Kato, M. The Biology of Biodiversity, (1999), Springer Verlag, Tokyo. 	
	<ul style="list-style-type: none"> • Kotwal, P.C. and S. Banerjee. Biodiversity Conservation – In Managed forest and Protected areas, (2002). Agrobios, India. 	
	<ul style="list-style-type: none"> • Krishnamurthy, K.V. An Advanced Textbook on Biodiversity – Principles and Practice (2003). Oxford and IBH Publishing, New Delhi. 	

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EVS4203: Atmospheric Sciences (Credits 4)

Chapter Title		Content	No of Lectures
1	Atmospheric science:	<ul style="list-style-type: none"> • Evolution of atmosphere; • Composition and structure of the atmosphere; • Need of atmospheric studies in environmental sciences; • Elements of weather and climate; • Weather parameters (temperature, wind, pressure, relative humidity, rainfall), • Climatology of weather parameters, long-term and short-term climatic effects. 	8
2	Insolation and Energy Balance:	<ul style="list-style-type: none"> • Insolation, Basic laws of radiation, black body radiation, • Factors affecting the distribution of Insolation, • Geographical and seasonal distribution of Insolation, • The energy system, Flux of solar energy in the biosphere, • Earth's radiation budget, Net radiation and latitudinal heat balance, • Greenhouse effect and Human influence on radiation balance. 	8
3	Temperature measurements and controls:	<ul style="list-style-type: none"> • Temperature measurements • Horizontal and vertical distribution of temperature, • Temperature inversion, • Types of inversion, • Temperature gradients, • Urban heat island effect. 	6
4	Atmospheric pressure and winds:	<ul style="list-style-type: none"> • Pressure measurement and distribution, • Wind observations, • Factors affecting wind, • Pressure and wind belts • local winds • Geostrophic and gradient winds. 	8
5	Atmospheric moisture:	<ul style="list-style-type: none"> • Condensation, Forms of precipitations, • Hydrological cycle, • Indian monsoon, • Inter-tropical convergence zone (ITCZ), • Models of general circulation of the atmosphere, • El-Nino, La-Nina phenomena, Walker circulation. 	8

6	Atmospheric stability and Air masses	<ul style="list-style-type: none"> • Atmospheric stability, • Dry adiabatic lapse rate and moist adiabatic lapse rate, • Environmental lapse rate. • Air masses, Classification and modifications of air masses • Analysis of air mass back trajectories, • Characteristics and types of fronts, the jet stream. 	6
7	Atmosphere hazards:	<ul style="list-style-type: none"> • Introduction to thunderstorm and lightening, • Tropical cyclone, hurricanes, • Global warming, • Ozone depletion, • Ocean Atmosphere, • Sea surface temperature, ocean currents. 	8
8	Environmental Meteorology:	<ul style="list-style-type: none"> • Introduction to the atmospheric chemical transport models, • emission inventory, • aerosol and gases pollutants, • national air quality standards and index, • dry and wet deposition fluxes of gases and aerosol pollutants, • Intercontinental and hemispheric transport of air pollutants. 	8

Reference Books:

- Lutgens F. K., Tarbuck, E. J. and Tasa, D. 2008. Essentials of Geology, Prentice Hall Publishers.
- Bell F. G., 1998. Environmental geology: principles and practice. Blackwell Sc.. Oxford.
- Thurman, H.V. and Trujillo, A.P., 2004, Introductory Oceanography, Prentice Hall.
- Randolph, J. 2004 Environmental land use planning and management, Island Press, Washington.
- Strahler, A.H and Strahler A.N (2002): Modern Physical Geography, John Wiley and Sons.
- Kale, V. S. and Gupta, A. 2001. Introduction to Geomorphology, Orient Longman, Calcutta.
- Chamley, H. and Chamley, H. 2003. Geosciences, Environment and Man Elsevier Science & Technology.
- Savindra Singh (2002): Geomorphology, PrayagPustakBhawan, Allahabad.

Deccan Education Society's

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Department of Environmental Science

EVS 4204:WATER AND WASTEWATER TECHNOLOGY (CREDITS 4)

Chapter Title		Content	No of Lectures
1	Water	<p>Water Requirements for Domestic Consumption.</p> <p>Population forecasting by the following methods.</p> <p>Demographic method, Arithmetical progression method, Geometrical progression method, Logistic methods, Graphical projection method, Final prediction.</p> <p>Quality of water required for – (a) Domestic, (b) Institutional (Schools, Hostels, Hospitals), (c) Fire fighting, (d) Commercial (Shopping complex, Hotels, Restaurant), (e) Industrial (Dairy, Sugar, Pulp and Paper, etc.) (f) Specific requirement at pilgrimage place and recreation activities.</p>	8
2	Impact of future growth, development, change in quality of life on water requirements.	<p>Types of solid in water and their impact on water quality.</p> <p>Need of water quality standards for domestic & industrial purpose.</p> <p>Specifications for drinking water (physical, chemical & bacteriological) by Bureau of Indian Standards & World Health Organization. Packaged drinking water.</p>	6
3	Water Treatment	<p>Water source, quality of raw water, solids in water & treatment process.</p> <p>Principal, Application & Designing of following Unit Operation in water treatment. a. Collection & pumping, b. Aeration, c. flocculation, d. Sedimentation, e. Filtration, f. Disinfections (Chlorination, UV, Ozonization), g. water softening.</p>	4

4	Advance treatment methods	a. Demineralization, b. Ultra filtration, c. Reverse osmosis, d. Color & odor removal by activated carbon, e. Iron removal. Selection of appropriate unit operations for the treatment and flow chart of water treatment plant.	6
5	Specification of treated wastewater	For disposal into surface water, on land & for treatment. a. Collection & pumping, b. Screen chamber, c. Grit chamber, d. Oil & grease removal, e. Dissolve air floatation.	6
6	Wastewater engineering for Biological Treatment	Principal, role of microorganisms, ecosystem & designing of following biological Unit Operation in waste water treatment. Aerobic and anaerobic treatment suspended and attached growth treatment processes. <ol style="list-style-type: none"> 1. Aerobic treatment: a. Activated sludge process b. Stabilization pond, c. Aerated lagoon, d. Tricking filter. e. Sequence batch reactor f. Rotating Biological contactor 2. Anaerobic treatment: a. Anaerobic packed Bed reactors b. Anaerobic Fluidized and Expanded bed Reactors c. UASB reactor etc. 	10
7	Sewage treatment	Impact of Future growth & development & change in quality of life on sewage quality & quantity. Unit operations for the treatment and flow chart of sewage treatment plant.	4
8	Industrial Wastewater	Selection of appropriate unit operations for the treatment and flow chart of wastewater treatment plant for a. Dairy, b. Pulp & Paper, c. Textile d.. Pharmaceutical, e. fertilizer, f. oil refineries.	8
9	Biotechnology & Waste Management	Application of biotechnology for the Treatment of followings: <ol style="list-style-type: none"> a. High strength waste e.g. whey (Dairy industry) & spent wash (Distillery), b. Phenol & cyanide removal. c. Sludge treatment processes 	8

References

- Water pollution – A. K. Tripathi and S. N. Pande
- Waste water engineering, treatment, disposal and reuse – Metcalf and Eddy.
- Water pollution – V.P. Kudesai
- Pollution control in process industry – S. P. Mahajan
- Introduction to waste water treatment process – Ramalho RS
- Environmental Pollution Control & Environmental Engineering; Rao C. S.; Tata McGraw Hill; New Delhi; 1994.
- Pollution Management; Agarwal S.K.
- Environmental Science; Daniel Chiras.
- Waste Water Engineering, Treatment, Disposal & Reuse; Metcalf & Eddy.
- Handbook of Methods in Environmental Studies Vol-I &II; Maiti S.K.; ABD Publishers; Jaipur.
- Physico-Chemical Examination of Water, Sewage & Industrial Effluents; Manivasakam N.; Pragati Prakashan; Meerut; 1984.
- Chemical & Biological Methods for Water Pollution Studies; Trivedi R.K. & Goel P.K.; Environmental Publications; Karad; 1986.

EVS4205: Environmental Science Practical - III (4 Credits)

Practicals based on Biodiversity, Conservation and Natural Resources (EVS 4202)

1. To find out Carrying Capacity of protected area
2. Plant species diversity in a sacred grove or forest area (one season data only)
3. Species wise population count of birds in a wetland
4. List of minor forest produce used by a community living inside or in the proximity of a Protected area
5. Establish micro-plan and action programme for village-level joint forest management committee and local communities
6. Develop a biodiversity register at village level near or within Protected Areas
7. Do flora species counts with local forest guards / forest officials in development or Verification of forest working plan
8. Develop and maintain a herbarium of flora species along a water stream in the hill areas of Pune, Nashik and Ahmadnagar Districts
9. Develop or verify or monitor and evaluate the conservation action plan for a protected area in collaboration with the forest department and the local village-level community
10. Develop or verify or monitor and evaluate the eco-tourism action plan near a protected area in collaboration with the forest department and the local village-level community
11. Identification and documentation of birds using e-bird resource

Practical based on Environmental Pollution I: Water and Soil (EVS4201)

1. Determination of COD from given water/waste water sample
2. Determination of DO from given water sample.
3. Estimation of oil and grease
4. Estimation of MPN/coliforms from given water sample
5. Estimation of standard plate count of bacteria from given water/soil sample.
6. Estimation of organic carbon and organic matter from given soil sample
7. Determination of sodium adsorption ratio of given water sample
8. Field visit to river/lake to study effect of pollution.

EVS4206: Environmental Science Practical - IV (4 Credits)

Practicals based on Atmospheric Sciences (EVS4203)

1. Estimation of distribution of solar radiation / insolation over Earth's surface
2. Exercises based on incoming and outgoing solar radiations
3. Plume dispersion model (case studies) (optional)
4. Diagrammatic representation of Climograph
5. Diagrammatic representation Wind roses Simple
6. Diagrammatic representation Wind roses Compound
7. Station Model - Coding decoding and plotting of synoptic data
8. Exercises based on adiabatic lapse rates (Graphical / Calculation)

Practicals based on Water and Wastewater Technology (EVS4204)

1. Designing of ETP/STP
2. Estimation of MLSS, MLVSS and Sludge volume index.
3. Study of coagulation and flocculation treatment by using jar test apparatus.
4. Study of Electrocoagulation for waste water treatment.
5. Study of Models of anaerobic digestion.
6. Study of physical properties (colour, odour, temperature, turbidity) of sewage.
7. Study of Chemical properties of sewage(Nitrate/phosphate)
8. Visit to ETP/STP.
9. Study of Photocatalytic treatment of wastewater
10. i) Solar photo catalysis ii) Advance oxidation processes