

Deccan Education Society's  
**FERGUSSON COLLEGE, PUNE**  
**(AUTONOMOUS)**

**SYLLABUS UNDER AUTONOMY**  
**S.Y. B.Sc.**  
**Environmental Science**

Semester	Course code	PAPER	Title of Paper	Credits	Suggestions
I	EVS2301	PAPER I	Ecology and Ecosystems	3 credits	Addition of Ecosystem structure and function
	EVS2302	PAPER II	Land and soil conservation and management	3 credits	Case studies related to land degradation, Visits to land sites included.
	EVS2303	PAPER III	Practicals based on EVS2301 and EVS2302	2 credits	Practicals based on theory
II	EVS2401	PAPER I	Urban Ecosystems	3 credits	Eco-housing and Green cities concept included.
	EVS2402	PAPER II	Natural resource management and sustainability	3 credits	Ecological footprint included
	EVS2403	PAPER III	Practicals based on EVS2301 and EVS2302	2 credits	Practicals based on theory

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**SEMESTER – I**

**Academic Year 2017-2018**

## EVS 2301: ECOLOGY AND ECOSYSTEMS

**Deccan Education Society's  
Fergusson College (Autonomous), Pune**

### EVS2301: ECOLOGY AND ECOSYSTEMS

**Theory (48 Lectures) Credits: 3**

**Preamble:** This paper will introduce to the students the basic understanding of ecosystem and its structural and functional aspects. It will explore the interconnectedness among all the biotic and abiotic components of environment and the dynamic nature of the ecological processes in maintaining equilibrium in nature.

Unit No.	Name of the Unit and Contents	No. of Lectures
1	<p style="text-align: center;"><b>Basics of Ecology</b></p> <ul style="list-style-type: none"><li>• Basic concepts, Principals, Scope</li><li>• Definitions: Ecology, landscape, habitat, ecozones, biosphere, ecosystems, Ecosystem stability, resistance and resilience</li><li>• Autecology, synecology</li><li>• Major terrestrial biomes</li></ul>	08
2	<p style="text-align: center;"><b>Ecology of Individuals</b></p> <ul style="list-style-type: none"><li>• Ecological amplitude; Liebig's Law of the Minimum; Shelford's Law of Tolerance; phenotypic plasticity</li><li>• ecotypes; ecoclines, acclimation</li><li>• ecological niche; types of niche: Eltonian niche, Hutchinsonian niche, fundamental niche, realized niche; niche breadth; niche partitioning; niche differentiation,</li><li>• Thermoregulation</li><li>• strategies of adaptation in plants and animals</li></ul>	08
3	<p style="text-align: center;"><b>Ecology of populations</b></p> <ul style="list-style-type: none"><li>• characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic,</li></ul>	08
4	<p style="text-align: center;"><b>Ecology of communities</b></p> <ul style="list-style-type: none"><li>• Community Characteristics: Qualitative, Quantitative, Synthetic</li><li>• keystone species,</li></ul>	08

	<ul style="list-style-type: none"> <li>• ecotone and edge effect;</li> <li>• species interactions: mutualism, symbiotic relationships, commensalism, amensalism, proto-cooperation, predation, competition, parasitism, mimicry, herbivory;</li> <li>• Ecological succession: Primary and secondary successions, models and types of successions, climax community concepts, examples of succession.</li> </ul>	
5	<p style="text-align: center;"><b>Ecosystem ecology</b></p> <ul style="list-style-type: none"> <li>• Types of ecosystem: forest, grassland, lentic, Lotic, estuarine, marine, desert, wetlands; ecosystem</li> <li>• Structure and function; abiotic and biotic components of ecosystem; ecosystem boundary;</li> <li>• Ecosystem function; ecosystem metabolism; primary production and models of energy flow</li> <li>• Secondary production and trophic efficiency ecosystem connections: food chain, food web; detritus pathway of energy flow and decomposition processes</li> <li>• Ecological efficiencies</li> <li>• Ecological pyramids: pyramids of number, biomass, and energy.</li> </ul>	08
6	<p style="text-align: center;"><b>Biogeochemical cycles and nutrient cycling</b></p> <ul style="list-style-type: none"> <li>• Carbon cycle;</li> <li>• nitrogen cycle;</li> <li>• phosphorus cycle;</li> <li>• sulphur cycle;</li> <li>• hydrological cycle;</li> <li>• nutrient cycle</li> <li>• models; ecosystem input of nutrients; biotic accumulation; ecosystem losses; nutrient supply and uptake;</li> <li>• Role of mycorrhizae; decomposition and nutrient release; nutrient use efficiency; nutrient budget;</li> <li>• Nutrient conservation strategies.</li> </ul>	08
<b>Suggested Readings</b>		
<p>1. Groom. B. &amp; Jenkins. M. 2000. <i>Global Biodiversity: Earth's Living Resources in the 21<sup>st</sup> Century</i>. World Conservation Press, Cambridge, UK.</p> <p>2. Gurevitch, J., Scheiner, S. M., &amp; Fox, G. A. 2002. <i>The Ecology of Plants</i>. Sinauer associates incorporated.</p>		

	<p>3. Loreau, M. &amp; Inchausti, P. 2002. <i>Biodiversity and Ecosystem functioning: Synthesis and Perspectives</i>. Oxford University Press, Oxford, UK.</p> <p>4. Odum, E.P. 1971. <i>Fundamentals of Ecology</i>. W.B. Saunders.</p> <p>5. Pandit, M.K., White, S.M.&amp; Pocock, M.J.O. 2014. The contrasting effects of genome size, chromosome number and ploidy level on plant invasiveness: a global analysis. <i>New Phytologist</i> <b>203</b>: 697-703.</p> <p>6. Pimentel, D. (Ed.). 2011. <i>Biological invasions: Economic and environmental costs of alien plant, animal, and microbe species</i>. CRC Press.</p> <p>7. Singh, J.S., Singh, S.P. &amp; Gupta, S.R. 2006. <i>Ecology, Environment and Resource Conservation</i>. Anamaya Publications.</p> <p>8. Wilson, E. O. 1985. The Biological Diversity Crisis. <i>BioScience</i> <b>35</b>: 700-706.</p>	
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## EVS2302: LAND AND SOIL CONSERVATION AND MANAGEMENT

Deccan Education Society's Fergusson College (Autonomous), Pune		
	<b>EVS2302: LAND AND SOIL CONSERVATION AND MANAGEMENT Theory (48 Lectures) Credits: 3</b>	
<p><b>Preamble:</b> This paper introduces students to the fundamentals of land and soil degradation. Each unit covers a range of topics, which will help students develop basic understanding of properties of soil and how the quality of land and soil degrades due to anthropogenic activities.</p>		
Unit No.	Name of the Unit and Contents	No. of Lectures
1	<p style="text-align: center;"><b>Introduction</b></p> <ul style="list-style-type: none"> <li>• Land as a resource</li> <li>• The concept of soil health</li> <li>• Ecological and economic importance of land</li> <li>• Types and causes of soil degradation</li> <li>• Impact of soil loss and land degradation</li> <li>• Need for soil conservation and restoration of soil fertility</li> </ul>	08
2	<p style="text-align: center;"><b>Fundamentals of soil science</b></p> <ul style="list-style-type: none"> <li>• Soil water and contaminants</li> <li>• Soil structure</li> <li>• Soil air and temperature</li> <li>• Ion exchange processes in soil</li> <li>• Soil colloids and Clays</li> <li>• Soil Ecology</li> <li>• Soil microbes and their importance</li> <li>• Soil humus reactions</li> </ul>	08
3	<p style="text-align: center;"><b>Soil degradation - causes</b></p> <ul style="list-style-type: none"> <li>• Soil resistance and resilience</li> <li>• Nature and types of soil erosion</li> <li>• Losses of soil moisture</li> <li>• Nutrient depletion</li> <li>• Soil pollution: agriculture , mining and mineral extraction, industrial and urban development, toxic organic chemicals, organic contaminants</li> </ul>	08
4	<p style="text-align: center;"><b>Land use changes and land degradation - causes</b></p> <ul style="list-style-type: none"> <li>• Biological and physical phenomena in land degradation</li> <li>• Drivers of land degradation - deforestation, desertification; rangeland degradation, urban encroachment , monoculture, industrial expansion</li> <li>• Social aspects of land degradation :human population pressure,</li> </ul>	08

	<p>poverty, socio-economic and institutional factors</p> <ul style="list-style-type: none"> <li>• Drivers of land use and land cover change in major geographic zones and biodiverse regions - the Himalaya and the Western Ghats</li> </ul>	
<b>5</b>	<p style="text-align: center;"><b>Environmental impacts of land degradation</b></p> <ul style="list-style-type: none"> <li>• Economic valuation of land degradation</li> <li>• Evaluation of onsite and offsite land degradation</li> <li>• Loss of ecosystem services</li> <li>• Farming communities</li> <li>• Food security</li> <li>• Nutrient cycles</li> <li>• Emerging threats of land degradation to developing countries</li> </ul>	<b>08</b>
<b>6</b>	<p style="text-align: center;"><b>Controlling land degradation</b></p> <ul style="list-style-type: none"> <li>• Afforestation and timber alternate</li> <li>• Ecofarming, ecotechnologies and Green business</li> <li>• Management on overgrazing</li> <li>• Management of irrigation</li> <li>• Management of mining and quarrying</li> <li>• Management of agricultural intensification</li> <li>• Land reclamation and Bioremediation</li> <li>• Soil solarization</li> <li>• Watershed management and techniques</li> <li>• RS and GIS as tool</li> </ul>	<b>08</b>
<b>Reference Books</b>		
	<ul style="list-style-type: none"> <li>• A Textbook of Soil Science – J.A. Daji – Media Promoters and Publ. Pvt. Ltd. Mumbai</li> <li>• Environmental Chemistry – B.K. Sharma</li> <li>• Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Edt..</li> <li>• Handbook of Methods in Environmental Studies Vol-I &amp;II; Maiti S.K.; ABD Publishers; Jaipur</li> <li>• Environmental Chemistry, Dey A. K.; New Age International Publishers; 6 Edt..</li> </ul>	

**PAPER CODE: EVS2303**

**PAPER CODE: EVS2303**

[Credits - 2: No. of Practicals Any 10]

**PAPER – III: ENVIRONMENTAL SCIENCE PRACTICAL - III**

**PRACTICALS: BASED ON THE THEORY/FIELDWORK.**

**EVS2301: ECOLOGY ECOSYSTEM**

1	Study of grassland vegetation by List Count Quadrat Method to determine the Frequency, Density & Abundance.
2	Study of phenograms of the species from surrounding area.
3	Study of primary productivity from grassland community.
4	Study of species interactions from forest area
5	Estimation of IVI from collected vegetation data.
6	Study of wetland (source region visit) and its vegetation and seasonal bird diversity
7	Visit to a sacred grove/Forest / Grassland / Marine ecosystem to assess its biodiversity.
8	Continuation of Use of social media for e-networking and dissemination of ideas on environmental issues pertaining to the course

**PRACTICALS: BASED ON THE THEORY/FIELDWORK.**

**EVS2302: LAND AND SOIL CONSERVATION AND MANAGEMENT**

1	Estimation of soil bulk density from given soil sample
2	Estimation of field capacity of given soil sample
3	Determination of lime or gypsum requirement for acidic soil.
4	Estimation of Available nitrogen from given soil sample
5	Estimation of phosphate from given soil sample
6	Estimation of Sodium from given soil sample
7	Visit to agricultural college/ soil survey department
8	Continuation of Use of social media for e-networking and dissemination of ideas on environmental issues pertaining to the course



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**SEMESTER – II**

**Academic Year 2017-2018**

## EVS 2401: URBAN ECOSYSTEMS

**Deccan Education Society's  
Fergusson College (Autonomous), Pune**

**EVS2401:URBAN ECOSYSTEMS**

**Theory (48 Lectures) Credits: 3**

**Preamble:** The paper is designed to enable the students to examine the existing environmental issues, conflicts and their potential role in urban development. It beholds importance as interaction between urban society and its environment transpires in governance and policy decisions. It also aims to address key challenges posed by increasing development to far-reaching goal of sustainability in urban areas.

Unit No.	Name of the Unit and Contents	No. of Lectures
1	<p style="text-align: center;"><b>Introduction</b></p> <ul style="list-style-type: none"> <li>• What is Urban ecosystem,</li> <li>• Meaning and concept</li> <li>• Introduction to urbanization; urban sprawl and associated environmental issues</li> <li>• Man as the driver of urban ecosystem</li> <li>• increasing challenges posed by modernity for the environment</li> </ul>	<b>08</b>
2	<p style="text-align: center;"><b>Environment in an urban setting</b></p> <ul style="list-style-type: none"> <li>• Commodification of nature; metros, cities and towns as sources and sinks of resources</li> <li>• Resource consumption and its social, cultural, economic and ecological perspectives;</li> <li>• Urban transformation;</li> <li>• Urban pollution (air, water, soil)</li> </ul>	<b>08</b>
3	<p style="text-align: center;"><b>Urban dwelling</b></p> <ul style="list-style-type: none"> <li>• Housing scenario across a range of large-medium-small cities; poverty and slums in an urban context;</li> <li>• Town planning Acts and their environmental aspects;</li> <li>• Energy consumption and waste disposal as well as accumulation;</li> <li>• Environmental costs of urban infrastructure</li> <li>• Eco-housing</li> </ul>	<b>08</b>
4	<p style="text-align: center;"><b>Urban interface with the environment</b></p> <ul style="list-style-type: none"> <li>• Management of urban environment</li> </ul>	<b>08</b>

	<ul style="list-style-type: none"> <li>• alternative resources</li> <li>• policy and management decisions</li> <li>• urban settings as loci of sustainability</li> <li>• Challenges associated with sustainability and urban future</li> <li>• Ecological footprint</li> </ul>	
5	<p style="text-align: center;"><b>Natural spaces in a city</b></p> <ul style="list-style-type: none"> <li>• Concept of ‘controlled nature’;</li> <li>• scope, importance and threats to nature in the city</li> <li>• organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts;</li> <li>• urban natural forest ecosystem as green lungs</li> <li>• Urban woodland</li> </ul>	<b>08</b>
6	<p style="text-align: center;"><b>Planning and environmental management</b></p> <ul style="list-style-type: none"> <li>• Urban planning and its environmental aspects from historical and contemporary perspectives;</li> <li>• Benefits of environmental management;</li> <li>• Urban governance;</li> <li>• Political complexity of applying ecological science to urban policy and planning, Green cities.</li> </ul>	<b>08</b>
<b>Suggested Readings</b>		
<ol style="list-style-type: none"> <li>1. D’ Monte, Darryl. 1985. <i>Industry versus Environment Temples or Tombs</i>. Three Controversies, Delhi, CSE.</li> <li>2. Ernstson, H. 2011. <i>Re-translating nature in post-apartheid Cape Town: The material semiotics of people and plants at Bottom Road</i>. In: Heeks, R., (Ed.) Conference on “Understanding Development through Actor-Network Theory”, London School of Economics, 30 June, London.</li> <li>3. Gaston, K.J. 2010. <i>Urban Ecology</i>. Cambridge University Press, New York.</li> <li>4. Grimm, N. B., Faeth, S. H., et al. 2008. Global Change and the Ecology of Cities. <i>Science</i> <b>319</b>: 756-760.</li> <li>5. Hinchliffe, S. &amp; Whatmore, S. 2006. Living cities: Towards a politics of conviviality. <i>Science as Culture</i> <b>15</b>: 123–138.</li> <li>6. McIntyre, N.E. 2000. Urban ecology as an interdisciplinary field: differences in the use of ‘urban’ between the social and natural sciences. <i>Urban Ecosystems</i> <b>4</b>: 5-24.</li> <li>7. Montgomery, M.R. 2009. Urban Transformation of the developing world. <i>Science</i> <b>319</b>: 761-764.</li> <li>8. Richter, M. &amp; Weiland, U. (ed.). 2012. <i>Applied Urban Ecology</i>. Wiley-Blackwell, UK.</li> </ol>		

## EVS2402: Natural Resource Management and Sustainability

Deccan Education Society's Fergusson College (Autonomous), Pune		
<b>EVS2402: Natural Resource Management And Sustainability</b>		
<b>Theory (48 Lectures) Credits: 3</b>		
<p><b>Preamble:</b> This paper takes an objective view of the nature of Earth's resources, their generation, extraction and impact of human activities on earth's environment. The students are expected to understand effective management strategies. It aims to provide an idea of effective management strategies and a critical insight of the major sustainability issues</p>		
Unit No.	Name of the Unit and Contents	No. of Lectures
1	<p style="text-align: center;"><b>Introduction</b></p> <ul style="list-style-type: none"> <li>• Resource and reserves</li> <li>• Renewable and non-renewable resources</li> <li>• Resource conservation</li> <li>• Resource availability and factors influencing its availability</li> <li>• Land resources; water resources; fisheries and other marine resources; energy resources; mineral resources</li> <li>• Human impact on natural resources</li> <li>• Ecological, social and economic dimension of resource management</li> </ul>	08
2	<p style="text-align: center;"><b>Natural resources and conservation</b></p> <ul style="list-style-type: none"> <li>• <b>Forest resources:</b> economic and ecological importance of forests, Forest management strategies, sustainable forestry</li> <li>• <b>Water resources:</b> supply, renewal, and use of water resources, freshwater shortages, strategies of water conservation</li> <li>• <b>Soil resources:</b> importance of soil, soil conservation strategies</li> <li>• <b>Food resources:</b> world food problem, techniques to increase world food production, green revolution.</li> </ul>	08
3	<p style="text-align: center;"><b>Mineral resources</b></p> <ul style="list-style-type: none"> <li>• Mineral resources and the rock cycle</li> <li>• Identified resources, undiscovered resources; reserves</li> <li>• Types of mining: surface, subsurface, open-pit, dredging, strip</li> <li>• Global consumption patterns of mineral resources</li> <li>• Techniques to increase mineral resource supplies</li> <li>• Ocean mining for mineral resources;</li> <li>• Environmental effects of mineral resource extraction</li> </ul>	08
4	<p style="text-align: center;"><b>Non-renewable energy resources</b></p> <ul style="list-style-type: none"> <li>• <b>Oil:</b> formation, exploration, extraction and processing, oil shale and tar sands</li> </ul>	08

	<ul style="list-style-type: none"> <li>• <b>Natural gas:</b> exploration, liquefied petroleum gas, liquefied natural gas</li> <li>• <b>Coal:</b> reserves, classification, formation, extraction, processing, coal gasification</li> <li>• <b>Environmental impacts</b> – oil spills, waste generation, health effects, damage to biodiversity, occupational diseases</li> <li>• Impact of energy consumption on global economy</li> <li>• Future challenges</li> </ul>	
5	<p style="text-align: center;"><b>Renewable energy resources</b></p> <ul style="list-style-type: none"> <li>• <b>Solar energy:</b> advantages, passive and active solar heating system, solar cells</li> <li>• <b>Hydropower:</b> principal, potential India/world, benefits of hydropower development</li> <li>• <b>Nuclear power:</b> nuclear fission, fusion, pros and cons of nuclear power, storage of radioactive waste</li> <li>• <b>Tidal energy; wave energy; ocean thermal energy conversion (OTEC)</b></li> <li>• <b>Geothermal energy</b></li> <li>• <b>Energy from biomass</b></li> </ul>	08
6	<p style="text-align: center;"><b>Resource management</b></p> <ul style="list-style-type: none"> <li>• Approaches in resource management: ecological approach; economic approach; ethnological approach</li> <li>• Implications of the approaches;</li> <li>• integrated resource management strategies</li> <li>• concept of sustainability science and development</li> <li>• resources and framework</li> <li>• sustainable energy strategy</li> <li>• principles of energy conservation;</li> <li>• Indian renewable energy programme</li> </ul>	08
<b>References</b>		
<ul style="list-style-type: none"> <li>• G. D. Rai, “Non-conventional Energy Sources” Khanna Publishers <b>ISBN:</b> 8174090738</li> <li>• J. R. Lamarsh and A. J. Baratta, “Introduction to Nuclear Engineering” Prentice Hall, New Jersey, <b>ISBN:</b> 0-201-82498-1</li> <li>• J. K. Shultis and R. E. Faw, “Fundamentals of Nuclear Science and Engineering” <b>Publisher:</b> Marcel Dckker, <b>ISBN:</b> 0824708342</li> <li>• Environment Science; Tyler M.G.; Wadsworth Publishing Co.; 1997</li> <li>• Perspective in Environmental Studies; Kaushik &amp; Kaushik; New Age International Pvt. Ltd. Publishers.</li> <li>• Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Edt..</li> <li>• Environmental Chemistry, Dey A. K.; New Age International Publishers; 6 Edt..</li> <li>• Handbook of Methods in Environmental Studies Vol-I &amp;II; Mailti S.K.; ABDPublishers; Jaipur.</li> <li>• Watershed manual by BK Kakde (BAIF and LEAD India publication)</li> <li>• Water Harvesting and Sustainable Supply in India by RN Athavale Centre for Environment Education <b>ISBN:</b> 8170337526</li> </ul>		

- Watershed Hydrology by Peter Black ; Lewis Publishers: ISBN 1575040271
- Soil and water conservation engineering by R. Suresh – Standard Publishers and Distributors ISBN 8180140008
- Restoration of Nature by Prakash Gole

**PAPER CODE: EVS2403**

**PAPER CODE: EVS2403**

**[Credits - 2: No. of Practicals Any 10]**

**Practicals based on EVS2401: Urban Ecosystems**

No	Title of Experiment/ Practical
1	Study of Water audit of residential complex
2	Study of Solid waste audit of residential complex
3	Study of Energy audit of residential complex
4	Develop/ monitor rain water harvesting plan of residential complex
5	Study the guide lines for landscape design and species selection
6	Visit to green Building/ Ecotel
7	Visit to decentralized unit of composting.
8	Continuation of Use of social media for e-networking and dissemination of ideas on environmental issues pertaining to the course

**Practicals Based on EVS2402: NATURAL RESOURCE MANAGEMENT AND SUSTAINABILITY**

No	Title of Experiment/ Practical
1	Estimation of calorific value of the given biomass
2	Estimation of heat of combustion of the given fuels
3	Estimation of Zink/Fe/Ni/ from given sample
4	Treatment of leachate artificial/collected from nearby mine/stone quarry (pH, EC, TDS, Turbidity )
5	Design and development of microbial fuel cell by using various biomasses
6	Design and development of biogas plant and measurement of its performance
7	Visit to school of energy studies/ nuclear chemistry laboratory of SPPU
8	Continuation of Use of social media for e-networking and dissemination of ideas on environmental issues pertaining to the course