

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

**Syllabus
for**

S. Y. B. Sc. (Environmental Science)

[Pattern 2019]

(B.Sc. Semester-III and Semester-IV)

From Academic Year

2020-21

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

S.Y.B.Sc. Subject (Pattern 2019)

From academic year 2020-21

Particulars	Name of Paper	Paper Code	Title of Paper	No. of Credits
S.Y. B.Sc. Semester III	Theory Paper - 1	EVS 2301	Ecology and Ecosystems	2
	Theory Paper - 2	EVS 2302	Land and Soil Conservation and Management	2
	Practical Paper - 1	EVS 2303	Practical's based on EVS 2301 and EVS 2302 Practical -III	2
S.Y. B.Sc. Semester IV	Theory Paper - 3	EVS 2401	Urban Ecosystems	2
	Theory Paper - 4	EVS 2402	Natural Resource Management and Sustainability	2
	Practical Paper - 2	EVS 2403	Practical's based on EVS2401 and EVS 2402 Practical -IV	2

S.Y. B.Sc. Semester III

Subject: Environmental Science Paper -1 (EVS_2301): Paper title: Ecology and Ecosystems

[Credits-2]

Course Outcomes	
At the end of this course, students will be able to	
CO1	Understand and apply basic concepts related to structural and functional aspects of ecosystems.
CO2	Students will be able to understand interconnectedness among biotic and abiotic components of Ecosystems
CO3	Students will observe and interpret the data related to Ecosystems
CO4	Students will be able to understand dynamic nature of ecological processes in maintaining the equilibrium in nature

Unit	Details	Lectures
I	<ul style="list-style-type: none"> Basics of Ecology Basic concepts, Principals, Scope Definitions: Ecology, landscape, habitat, ecozones, biosphere, ecosystems, Ecosystem stability, resistance and resilience Autecology, synecology Ecology of Individuals Ecological amplitude; Liebig's Law of the Minimum; Shelford's Law of Tolerance; phenotypic plasticity ecotypes; ecoclines, acclimation ecological niche; types of niche: Eltonian niche, Hutchinsonian niche, fundamental niche, realized niche; niche breadth; niche partitioning; niche differentiation, Thermoregulation strategies of adaptation in plants and animals 	[12]
II	<ul style="list-style-type: none"> Ecology of populations and communities Characteristics of population: density, dispersion, natality, mortality, life tables, survivorship curves, age structure; population growth: geometric, exponential, logistic. Community Characteristics, keystone species, ecotone and edge effect; species interactions: mutualism, symbiotic relationships, commensalism, amensalism, proto cooperation, predation, competition, parasitism, mimicry, herbivory; Ecological succession: Primary and secondary successions, models and types of successions, climax community concepts, examples of succession 	[12]
III	Ecosystem ecology <ul style="list-style-type: none"> Concept and Types of ecosystem: forest, grassland, lentic, lotic, estuarine, marine, desert, wetlands Structure and functions of ecosystem Abiotic and biotic components; ecosystem boundary Ecosystem function; ecosystem metabolism; primary production, secondary production, GPP, NPP and trophic efficiency, ecosystem connections: food chain, food web; models of energy flow, detritus pathway of energy flow and decomposition processes 	[12]

	<ul style="list-style-type: none">• Ecological efficiencies Ecological pyramids: pyramids of number, biomass, and energy. <p>Biogeochemical cycles</p> <ul style="list-style-type: none">• Types of biogeochemical cycles• Hydrological Cycle• Carbon cycle;• Nitrogen cycle;• phosphorus cycle;• sulphur cycle	
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Books-

1. Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Saunders.
2. Singh, J.S., Singh, S.P. & Gupta, S.R. 2006. *Ecology, Environment and Resource Conservation*. Anamaya Publications.
3. Wilson, E. O. 1985. The Biological Diversity Crisis. *BioScience* **35**: 700-706.

S.Y. B.Sc. Semester III**Subject: Environmental Science Paper 2 (2302)****Paper title: Land and Soil Conservation and Management****[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

CO1	Know the basic concept of land resources with respect to ecology, economy.
CO2	Be acquainted with fundamentals of pedagogy
CO3	Sensitize and aware the students about human impact on soil resource and its degradation.
CO4	Understand Drivers of Land Degradation and Management of it

Unit	Details	Lectures
I	<p>Introduction</p> <ul style="list-style-type: none"> • Land as a resource • The concept of soil health : important factors • Ecological importance of land :role in supporting all types of ecosystem • Economic importance of land: domestic, agricultural and industrial • Types and causes of soil degradation: water, wind, salinity, fertility, acidity, structure etc • Impact of soil loss and land degradation. • Need for soil conservation and restoration of soil fertility <p>Fundamentals of soil science</p> <ul style="list-style-type: none"> • Soil and water and contaminants : • Soil structure: process of formation of soil structures, Granular, blocky, prismatic, massive • Soil air: constituents of soil air, movement of gases, role in plant growth. • Soil Temperature: ideal temperature for plant growth, effect on air, nutrients. • Ion exchange processes in soil: Cation, Anion , importance in nutrient availability • Soil colloids : inorganic and organic colloids • Soil Ecology: soil microbes and their importance • Soil humus reactions 	[12]
II	<p>Soil degradation - causes</p> <ul style="list-style-type: none"> • Soil resistance and resilience • Nature and types of soil erosion • Losses of soil moisture • Nutrient depletion • Soil pollution and its causes: agricultural practices , mining and mineral extraction, industrial and urban development, toxic organic chemicals, organic contaminants 	[12]

	<p>Environmental Impacts of Land Degradation</p> <ul style="list-style-type: none"> • Cost of land degradation • Loss Ecosystem services : Effects of land degradation on provisioning, cultural, regulating and supporting services of ecosystem • Farming practices and associated problems • Food security: Components and challenges • Nutrient cycles : Biogeochemical cycles and its role in nutrient cycling • Emerging threats of land degradation: Effect on soil fertility, desertification etc. • Restoration of degraded land and its benefits 	
III	<p>Land Use Changes and Land Degradation: Causes</p> <ul style="list-style-type: none"> • Biological and Physical Phenomena in Land Degradation • Drivers of Land Degradation: Deforestation, Desertification, Rangeland Degradation, Urban Encroachment, Monoculture, Industrial Expansion • Social Aspects of Land Degradation: Human Population Pressure, Poverty, Socio-Economic and Institutional Factors • Drivers of LULC in Major Geographic Zones and Biodiverse Regions- The Himalaya and The Western Ghats. <p>Controlling Land Degradation</p> <ul style="list-style-type: none"> • Ecofarming and Ecotechnologies for Green Business • Management on Overgrazing • Management of Irrigation • Management of Mining and Quarrying • Management of Agricultural Intensification • Land Reclamation and Bioremediation • Soil Solarization • Watershed Management and Techniques • RS and GIS as Tool 	[12]

Books-

1. A Textbook of Soil Science – J.A. Daji – Media Promoters and Publ. Pvt. Ltd. Mumbai
2. Environmental Chemistry: B.K. Sharma
3. Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Ed.
4. Handbook of Methods in Environmental Studies Vol-I &II; Mailti S.K.; ABD Publishers; Jaipur
5. Environmental Chemistry, Dey A. K.; New Age International Publishers; 6 Edt..

S.Y. B.Sc. Semester III**Subject: Practical Paper -1 (EVS 2303)****Paper title: Practical's based on EVS 2301 and EVS 2302 Practical -III****[Credits-2]**

Course Outcomes	
At the end of this course, students will be able to	
CO1	Monitor parameters of forest and grassland ecosystem
CO2	Learn field techniques related vegetation and bird sampling and analysis
CO3	Perform assessment of soil nutrient with the help of standard instruments
CO4	Visit and understand working of district soil survey department

List of practical's (Compulsory 10 + 2 Activity)

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 g 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

S.Y. B.Sc. Semester IV**Subject: Environmental Science Paper -1 (EVS 2401): Paper title-Urban Ecosystems****[Credits-2]**

Course Outcomes	
At the end of this course, students will be able to	
CO1	Examine the existing environmental issues, Conflicts and their potential role in urban development.
CO2	Understand the importance as interaction between urban society and its environment transpires in governance and policy decisions.
CO3	Address key challenges posed by increasing development to far-reaching goal of sustainability in urban areas.
CO4	Understand and develop sensitivity towards various urban issues and it will help to find out innovative solutions for the same

Unit	Details	Lectures
I	<ul style="list-style-type: none"> • Introduction What is Urban ecosystem, Meaning and concept Introduction to urbanization; urban sprawl and associated environmental issues Man as the driver of urban ecosystem increasing challenges posed by modernity for the environment • Environment in an urban setting Commodification of nature; metros, cities and towns as sources and sinks of resources Resource consumption and its social, cultural, economic and ecological perspectives; Urban transformation; Urban pollution (air, water, soil) 	[12]
II	<p>Urban dwelling</p> <ul style="list-style-type: none"> • Housing scenario across a range of large-medium-small scale cities • Poverty and slums in an urban context • Issues of urban dwelling; Energy consumption and waste disposal as well as accumulation • Environmental costs of urban infrastructure • Ecological footprint <p>Urban interface with the environment</p> <ul style="list-style-type: none"> • Management of urban environment and alternative resources • Eco-housing • Policy and management decisions • Urban sustainability • Challenges associated with sustainability • Urban future scenario and predictions 	[12]
III	<p>Natural spaces in a city</p> <ul style="list-style-type: none"> • Concept of controlled nature • Scope, importance and threats to nature in the city • Organization and planning of green spaces such as parks, gardens and public spaces; concept of green belts • Urban natural forest ecosystem as green lungs • Urban woodland 	[12]

	Planning and environmental management <ul style="list-style-type: none">• Urban planning and its environmental aspects from historical and contemporary perspectives• Benefits of environmental management• Urban governance• Political complexity of applying ecological science to urban policy and planning• Green cities.	
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Books-

1. McIntyre, N.E. 2000. Urban ecology as an interdisciplinary field: differences in the use of urban between the social and natural sciences. *Urban Ecosystems* 4: 5-24.
2. Grimm, N. B., Faeth, S. H., et al. 2008. Global Change and the Ecology of Cities. *Science* 319: 756-760.

S.Y. B.Sc. Semester IV**Subject: Environmental Science Paper -1 (EVS 2401):****Paper title: Natural Resource Management and Sustainability****[Credits-2]****Course Outcomes**

At the end of this course, students will be able to

CO1:	Categorize of resource, reserve and classification of resources.
CO2:	Realize about current scenario of non- renewable energy resources
CO3:	Learn about challenges and opportunities of renewable energy resources.
CO4:	Understand sustainable management of resources

Unit	Details	Lectures
I	<p>Concept and classification of resources and reserves</p> <ul style="list-style-type: none"> • Resource: actual and potential • Identified resources, undiscovered resources; reserves • Renewable resources : air , biomass, soil, water, etc • Non-renewable resources: fossil fuels, minerals, metallic and non-metallic ores etc. <p>Mineral resources</p> <ul style="list-style-type: none"> • Mineral resources and the rock cycle • Types of mining: surface, subsurface, open-pit, dredging, strip • Ocean mining for mineral resources; • Environmental effects of mineral resource extraction <p>Soil Resources</p> <ul style="list-style-type: none"> • Importance of Soil • Soil Conservation Strategies <p>Marine resources</p> <ul style="list-style-type: none"> • Fisheries and other marine resources • Threats to costal and marine resources • Conservation Strategies <p>Human impact on natural resources</p> <ul style="list-style-type: none"> • Natural resource economics • Loss of resources, degradation of quality, overexploitation • Ecological, social and economic dimension of resource management 	[12]
II	<p>Renewable energy resources</p> <ul style="list-style-type: none"> • Solar energy: Passive and active solar heating system, Concept of Solar Cells, Advantages and limitations • Hydropower: Principle, potential, benefits and limitations • Nuclear Power: Nuclear fission and fusion reactions, pros and cons of Nuclear power, problem of storage and disposal of Radioactive waste • Ocean as energy resource : Introduction to Tidal Energy; Wave Energy; Ocean Thermal Energy Conversion (OTEC) • Geothermal Energy: Concept , benefits and limitations • Energy From Biomass: methods of biomass energy generation and its benefits. 	[12]

	<p>Non-renewable energy resources</p> <ul style="list-style-type: none"> • Types of fossil fuels: Oil , Natural gas ,Coal reserves, classification, formation, extraction, processing of fossil fuels • Environmental impacts : oil spills, waste generation, health effects,damage to biodiversity, occupational diseases • Impact of energy consumption on global economy • Future challenges 	
III	<p>Natural Resources and Conservation</p> <ul style="list-style-type: none"> • Forest Resources: Economic and Ecological Importance of Forests, Forest Management Strategies, Sustainable Forestry • Water Resources: Supply, Renewal, and Use of Water Resources, Freshwater Shortages, Strategies of Water Conservation • Food Resources: World Food Problem, Techniques to Increase World Food Production, Green Revolution <p>Sustainable Resource Management</p> <ul style="list-style-type: none"> • Concept of Sustainability Science and Development • Framework for Resource Conservation • Integrated Resource Management Strategies • Approaches in Resource Management: Ecological approach; Economic Approach; Ethnological Approach • Principles Strategies of Energy Conservation • Indian Renewable Energy Programme • Case Studies: National and International 	[12]

Books-

1. G. D. Rai, "Non-conventional Energy Sources" Khanna Publishers **ISBN:** 8174090738
2. J. R. Lamarsh and A. J. Baratta, "Introduction to Nuclear Engineering" Prentice Hall, New Jersey, **ISBN:** 0-201-82498-1
3. J. K. Shultis and R. E. Faw, "Fundamentals of Nuclear Science and Engineering"
Publisher: Marcel Dckker, **ISBN:** 0824708342
4. Environment Science; Tyler M.G.; Wadsworth Publishing Co.; 1997
5. Perspective in Environmental Studies; Kaushik & Kaushik; New Age International Pvt. Ltd. Publishers.
6. Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Edition.
7. Environmental Chemistry, Dey A. K.; New Age International Publishers; 6 Edition.
8. Handbook of Methods in Environmental Studies Vol-I &II; Maiti S.K.; ABD Publishers; Jaipur.
9. Watershed manual by BK Kakde (BAIF and LEAD India publication)
Water Harvesting and Sustainable Supply in India by RN Athavale, Centre for Environment Education **ISBN:** 8170337526

S.Y. B.Sc. Semester IV**Subject:** Practical Paper - 2 (EVS 2403):**Paper title:** Practical's based on EVS2401 and EVS 2402 Practical -IV**[Credits-2]**

Course Outcomes	
At the end of this course, students will be able to	
CO1	Understand and evaluate parameters of Urban ecosystem
CO2	Monitor and audit natural resources like water, energy, etc.
CO3	Analyse important resources through various instruments
CO4	Visit various institutes working in the field of natural resource management

List of practical's (Compulsory 10 + 2 Activity)**PAPER – III: ENVIRONMENTAL SCIENCE PRACTICAL - IV****Practical's 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

Practical's 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
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- 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