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		
Title of the Course and Course Code	**Ecology and Ecosystems (EVS 2301)**	**Number of Credits : 02**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Outline levels and applications of Ecology. Differentiate between classical and modern day theories of Ecology.	
CO2	Compare community characteristics.	
CO3	Apply skills for identifying keystone species and outline the concept of Ecosystems.	
CO4	Differentiate types of ecosystems and identify biotic and abiotic components.	
CO5	Compare and contrast different biogeochemical cycles.	
CO6	Execute and organize skills to classify different types of ecosystems and biogeochemical cycles.	

Unit. No.	Title of Unit and Contents	No of Lectures
I	• **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	• **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, protocooperation, 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**	**12**

	• 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 • Ecological efficiencies Ecological pyramids: pyramids of number, biomass, and energy. **Biogeochemical cycles** • Types of biogeochemical cycles • Hydrological Cycle • Carbon cycle; • Nitrogen cycle; • phosphorus cycle; • sulphur cycle	

Learning resourses:

1. Odum, E.P. 1971. *Fundamentals of Ecology*. W.B. Sounders.

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		
Title of the Course and Course Code	**Land and Soil Conservation and Management (2302)**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Recall different concepts and important key terms of soil health. Identify the factors affecting soil and responsible for degradation.	
CO2	Discuss drivers of Land degradation and management. Compare the land management practices followed in developing and developed world as per social needs	
CO3	Examine the advanced techniques for effective management of land. Apply eco-friendly technologies for management of land.	
CO4	Differentiate between soil resistance and resilience. Classify and describe soil erosion processes. Identify different causes of soil erosion.	
CO5	Evaluate ecosystem services and identify threats associated with it. Identify the challenges associated with food security.	
CO6	Write a report on behavior of cations and anions in nutrients transport from soil to plant. Analyze ecological and economical importance of soil and their role in its conservation.	

Unit. No.	Title of Unit and Contents	No of Lectures
I	**Introduction** • 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 **Fundamentals of soil science** • 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	**Soil degradation - causes** • 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 **Environmental Impacts of Land Degradation** • 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	12
III	**Land Use Changes and Land Degradation: Causes** • Biological and Physical Phenomena in Land Degradation	12

	• 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. **Controlling Land Degradation** • 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	

Learning resourses:

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		
Title of the Course and Course Code	**Practical's based on EVS 2301 and EVS 2302 Practical -III (EVS 2303)**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Recall and analyze frequency, density and abundance of vegetation. Outline different methods to understand the healthiness of ecosystems with respect to vegetation and soil.	
CO2	Compare methods used for study of the grassland ecosystem. Evaluate lime or gypsum requirement for treatment of soil.	
CO3	Analyze available nitrogen and phosphate from soil samples.	
CO4	Illustrate chemicals and methods used for estimation of different soil parameters.	
CO5	Compare above and below ground primary productivity of the grassland community. Evaluate field capacity and bulk density of soil.	
CO6	Write a report on vegetation diversity by applying IVI. Build phenograms of the species from the surrounding area.	

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		
Title of the Course and Course Code	**Urban Ecosystems (EVS 2401)**	**Number of Credits : 02**
Course Outcomes (COs) On completion of the course, the students will be able to:		
CO1	Illustrate the urban ecosystem and elements associated with it. Examine the existing environmental issues, conflicts and their impact in urban development.	
CO2	Recall the importance of interaction between urban society and relate it to environment governance and policy decisions.	
CO3	Examine housing scenarios at different scales of cities and identify urban Environmental issues associated with it.	
CO4	Determine ecological footprint by connecting environmental variables.	
CO5	Identify key challenges posed by increasing development to the farreaching goal of sustainability in urban areas.	
CO6	Evaluate the importance of Eco-housing and Green cities and integrate them in planning and development for innovative solutions	

Unit. No.	Title of Unit and Contents	No of Lectures
I	• **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	**Urban dwelling** • 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 **Urban interface with the environment** • Management of urban environment and alternative resources • Eco-housing • Policy and management decisions	**12**

	• Urban sustainability • Challenges associated with sustainability • Urban future scenario and predictions	
III	**Natural spaces in a city** • 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 **Planning and environmental management** • 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.	**12**

Learning resources:

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		
Title of the Course and Course Code	**Natural Resource Management and Sustainability (EVS 2402)**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Recall the types of resources, concepts of resource base, resource reserve. Outline different types of mines.	
CO2	Discuss sustainable management of food, water and forest resources in relation with future development.	
CO3	Outline different renewable energy resources and compare their energy efficiency.	
CO4	Compare different frameworks followed for resource conservation. Analyze sustainable conservation approaches followed in different societies.	
CO5	Evaluate impact of energy consumption on the global economy. Classify different fossil fuels and discuss their environmental impact.	
CO6	Write a report on different types of resources, their availability, exploitation and on the ecological, social and economic dimension of resource management.	

Unit No.	Title of Unit and Contents	No of Lectures
I	**Concept and classification of resources and reserves** • 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. **Mineral resources** • 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 **Soil Resources** • Importance of Soil • Soil Conservation Strategies **Marine resources** • Fisheries and other marine resources • Threats to costal and marine resources • Conservation Strategies **Human impact on natural resources** • Natural resource economics • Loss of resources, degradation of quality, overexploitation • Ecological, social and economic dimension of resource management	**12**

II	**Renewable energy resources** • **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. **Non-renewable energy resources** • **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	**12**
III	**Natural Resources and Conservation** • **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 **Sustainable Resource Management** • 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**

Learning Resources:

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; Mailti 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		
Title of the Course and Course Code	**Practical's based on EVS2401 and EVS 2402 Practical -IV Practical Paper - 2 (EVS 2403)**	**Number of Credits : 02**
Course Outcomes (COs) **On completion of the course, the students will be able to:**		
CO1	Describe resource consumption methods used for Green building / Ecotel. Practice composting for effective solid waste management. Compare methods used for urban planning by on field observations.	
CO2	Estimate calorific value of biomass sample.	
CO3	Illustrate chemicals and methods used for estimation of Zinc, Iron and Nickel. Express results by comparing standard values.	
CO4	Analyze water utilization at household level and collect data for conducting water audit. Enumerate types and sources of solid wastes and evaluate energy consumption pattern.	
CO5	Compare methods used for treatment of leachate/collected from nearby mine/stone quarry.	
CO6	Design and develop a biogas plant and measurement of its performance.	

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
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