University of Pune

S.Y.B.Sc.
Environmental Science
Revised Syllabus 2020-21
Course Design

Semester	Paper	Course code	Course Title	Credits	Marks Distribution			
					Internal	University	Subtotal	Total
I	I	EVS – 231	Ecology & Ecosystem	02	15	35	50	150
	II	EVS – 232	Natural Resource Conservation and Management	02	15	35	50	
	III	EVS – 233	Practical Course Based on EVS - 231 & EVS – 232	02	15	35	50	
II	I	EVS-241	Biological Diversity & its Conservation	02	15	35	50	150
	II	EVS-242	Environmental Pollution Control Technology	02	15	35	50	
	III	EVS-243	Practical Course Based on EVS - 241 & EVS - 242	02	15	35	50	
				Total = 12				300

Semester – I, Paper – I, EVS – 231

Ecology & Ecosystem

(Total Lectures- 40)

Unit No.	Name of the Unit	Content	Lectures
1.	**Ecology**	• **Introduction & Interdisciplinary nature of Ecology.** • **Levels of Organisation –** a) Biological / Ecological Spectrum. b) Ecological Hierarchy by Barett et al. • **Ecological Classification based on –** a) Taxonomic Affinity (From Kingdom to Species Level Ecology). b) Habitat Types (Terrestrial & Aquatic Ecology). c) Levels of Organisation (Autecology & Synecology – Population, Community, Biome & Ecosystem Ecology)	**08**
2.	**Ecosystem Structure & Function – Energy Flow**	• **Concept** of the Ecosystem. • **Macro & Micro-ecosystems …etc.** • **Ecosystem Structure** – Abiotic & Biotic Components. • **Ecosystem Function : Functional attributes-** a) Food Chain – Grazing & Detritus. b) Food Web & Ecosystem Stability c) Ecological Energetics – i) Energy Input. ii) Energy Flow – Single Channel & Y shaped models. d) Productivity of Ecosystem – i) Primary Production – GPP & NPP. ii) Secondary Production. iii) Standing Crop (Biomass). e) Ecological Pyramids – of Number, Biomass & Energy with examples	**08**
3.	**Ecosystem Function : Nutrient Cycling**	• **Concept of –** a) Macro & Micro-nutrients, deficiency syndrome, Functions b) Nutrient Cycling-- Biogeochemical Cycles – • **Gaseous Cycles** – Hydrological, Carbon & Nitrogen Cycles. • **Sedimentary Cycles** – Phosphorus & Sulphur Cycles. • **Human Impact** on Biogeochemical Cycles. • **Ecosystem Nutrient Cycling Model – Intra-system Cycling & Extra-system Transfers.** a) Nutrient Inputs. b) Biotic Accumulation of Nutrient. c) Nutrient Outputs.	**08**

4.	**Population Ecology**	• **Introduction & Basic Concepts.** • **Population Characteristics** – a) Size & Density. b) Dispersion – Random, Aggregate & Uniform. c) Natality (Potential & Realised). d) Fecundity e) Mortality (Potential & Realised). f) Survivorship Curves. g) Age & Sex Structure. h) Life Table and Viability analysis • **The Concept of Carrying Capacity.** • **Population Growth –** a) Growth Curves – Exponential & Logistic. b) Population Fluctuation. c) Biotic Potential & Environmental Resistance.	**08**
5.	**Community Ecology and Succession**	• **Characteristics of Community** - Species Diversity, Growth form & Structure, Dominance, Succession, Trophic Structure, Ecological Niche, Ecotone & Edge Effect. • **Characters used in Community Structure-** a) Analytical Characters – i) Quantitative. ii) Qualitative. b) Synthetic Characters. • **Inter-specific & Intra-specific Relationships.** • **Causes** of Succession. • **Basic Types** – Primary, Secondary, Autogenic, Allogenic …etc. • **Mechanism** of Succession – a) Nudation. b) Invasion. c) Competition, Co-action & Reaction. d) Stabilisation (Climax). • **Models** of succession – a) Hydrosere. b) Lithosere.	**08**

Semester – I , Paper – II, EVS – 232

Natural Resources & their Management (Total Lectures- 40)

Unit No.	Name of the Unit	Content	Lectures
1.	**Resources**	• **Meaning and Definition** • **Classification of Resources** 1. On the basis of Origin: Biotic & Abiotic 2. On the basis of recovery rate: Renewable and Non Renewable 3. Natural and Artificial Resources 4. Material and Energy Resources • **Importance and Scope** of Resources • **Nature** of Resources : Regenerative and Assimilative Capacity of Earth • **Man's Interaction with Natural Resources**: 1. An important resource 2. A waste sink 3. Cultural Significance • **Problems** associated with Natural Resources	**08**
2.	**Forest and Mineral Resources**	A. **Forest Resources** : • Function of Forest : Protective, Productive, Regulative and Accessory • Importance of Forest : Ecological and Economical • Human Interaction with Forest : Overexploitation, Deforestation (Causes and Effects) • Forest Management in India—JFM, EDP, Protected Areas • Case studies on Timber extraction, Dam construction and its effect on tribal people B. **Mineral Resources** • Origin of Mineral Resources with examples • Need of Mineral Resources • Overexploitation of Mineral Resources • Effects of Mining on Ecosystem with case studies. • Conservation of Mineral resources and its importance	**08**
3.	**Food Resources**	• **World Food Problems**: a) Increasing World Food Demand. b) Nutritional deficiency in food. c) Food Distribution. • **The Green Revolution in India**- Concept, Its Impacts in India. • Introduction of Hybrid Varieties-HYV and Genetically Modified Crops. • Effects of Modern Agriculture technologies • Genetically Modified Crops & Regulations in India • **Fertilizer-Pesticide Problems** –NPK Fertilizers	**08**

4.	**Water Resources**	• **Use and over-utilization** of surface and ground water, • Under-ground water pollution • Water Crisis--- the reasons • Conflicts over water ---World and India • **Conservation & Management** a) Traditional Methods. b) Rain-water Harvesting & Ground Water Recharge. c) Watershed Management– the concept. d) Flood and flood plain management	**08**
5.	**Land Resource**	• **Traditional & Modern Agricultural Systems** • **Major causes of soil degradation**: Soil erosion, Pollution , Use of fertilisers, pesticides, heavy metals, Plastic pollution • **Consequences of soil erosion** a) Decline of soil fertility b) Water logging c) Salinity d) Shifting / jhum cultivation • **Soil conservation methods** • **Sustainable Agriculture Methods**	**08**

Semester – II, Paper – I, EVS -241,

Biological Diversity & its Conservation (Total Lectures- 40)

Unit No.	Name of the Unit	Content	Lectures
1.	**Biological Diversity – Ecosystem Diversity**	**Biological Diversity---** • The Concept, Definition • Levels – Ecosystem, Species & Genetic. • Methods of assessment of Biological diversity **Ecosystem Diversity** • Classification of Ecosystem – a) Udvardy's Classification. b) Bailey's Classification. c) Olsen's Classification. d) Holdridge's Classification. • **Major Ecosystem types of India** with their physical & biological characteristics. • **Major Ecosystem types of the World** with their physical & biological characteristics. • **Importance of Ecosystem in maintaining Ecological balance**	**08**
2.	**Species Diversity**	a) **Species Diversity** at Local , National and International Level b) Special features and Latest estimates for major groups of Plants, Animals & Microbes. • **Measuring Species Diversity** – Species Richness, Species Abundance and Species Evenness. • **Factors** affecting global distribution of Species Richness – Latitudinal, Altitudinal, Rainfall gradients, temperature …etc. • **Endemism** – a) The Concept. b) Types with Examples. c) Endemism in India. • **Centers of Diversity** – a) The Concept. b) Centers of Diversity : Analyses at Global Level – • **Concept of hotspot** i) Myer's Hot-spots. ii) Mega-diversity Centers / Countries. **c) Western Ghat as a Hot-spot.** d) **India as a Mega-diversity Country**.	**08**
3.	**Genetic Diversity**	• **Meaning & Introduction** to Genetic Variations in Species. • **Nature & Origin** of Genetic Variations. • **Factors** affecting Genetic Diversity. • **Darwin's theory of Evolution and Lamarck's theory of Natural Selection** • **Measurement of Genetic Diversity** – a) Based on DNA & Chromosomes. b) Molecular Marker Techniques. • **Transgenic Organisms**. • **Diversity in Domesticated Species** –	**08**

		a) Variations since the first domestication to the present. • Land Races, Advanced Cultivars, Wild Relatives of Cultivated Plants & Feral Plants.	
4.	**Significance & Threat to Biodiversity**	**(Significances)** • Ecological Significances – Contribution of Biodiversity to various Eco- Services. • Non Ecological Significances – Nutritional, Medicinal, Aesthetic, Cultural, Commercial Values …etc. • Optional Values, Use of microorganism in remediation of pollution **(Threats)** • Threats with suitable Examples – a) Large Scale Dev. Projects – Habitat Destruction & Fragmentation. b) Changing Agri. & Forestry Practices. c) Invasion by Introduced Species. d) Over-exploitation. e) Environment Pollution. f) Global Climate Change. g) Loss of Traditional Knowledge. h) Nature of Legal & Mgmt. System – Human Wildlife Conflict. i) Genetically Modified Organisms ...etc.	**08**
5.	**Biodiversity Conservation**	• **Conservation Methods** – In-situ & Ex-situ methods with Example. • **National Conservation Efforts –** a) The laws – Environment Protection Act, Forest Act, Wildlife Act, Biodiversity Act 2002 b) Involving People's Participation – NBSAP, PBR c) Involving Community Participation – JFM, EDP d) People's Movement – Silent Valley Movement, Beej Bachao Andolan • **International Conservation Efforts –** a) IUCN – The World Conservation Union. b) CBD. c) CITES. • **Traditional Methods of Conservation** – Sacred Groves / Ponds / Species, Periodic restrictions on resource harvesting …etc. • **Need & Awareness**.	**08**

Semester – II, Paper – II, EVS – 242

Environmental Pollution Control Technology

(Total Lectures- 40)

Unit No.	Name of Unit	Content	Lectures
1	**Air Quality Parameters and Monitoring**	**Air Quality Monitoring** • **National standards** for ambient air quality by WHO • **Site and Parameter selection**, • **Air Sampling Techniques** • **Monitoring** of important **ambient air components** such as Particulate matter (PM) of 10 micron or less in size and 2.5 micron and less in size, Oxides of Sulfur, Nitrogen, Carbon monoxide • **Methods of analysis of SOx , NOx** • **Monitoring tools/instruments** used for the same and its work principle, Stack gases monitoring technique • **Plume behaviour**	**08**
2	**Water Quality Monitoring**	• **Purpose/objectives** of monitoring • **Water Quality Monitoring Protocol** • **Collection of sample** (types of sample, chain of custody, sampling method, number of samples, sample containers, sample volume, etc.) • **Sample preservation**, handling & storage guidelines/criteria • **Water quality monitoring** on field test parameters, off-field test parameters • **Waste Water Treatment**: a) Primary Treatment – Screening, Grit removal, Sedimentation b) Secondary Treatment - • Aerobic Method- i) Activated Sludge Process. ii) Trickling Filter. iii) Rotating Contractor iv) Oxidation Pond • Anaerobic Method. d) Tertiary Treatment – Disinfection (Chlorination). e) Biogas—one stage and second stage digester, Principle	**08**
3	**Soil Quality Monitoring**	• **Objectives** of soil monitoring/testing • **Sampling** and sample units; sample number, frequency and timing; Sampling methodology a. Site selection b. Infield sampling technique c. Describing the soil profile d. Site description e. Setting a transect instruments / Equipment used	**08**

		• Guidelines for handling and storage of samples • Physiochemical and Biological parameters **Biological Method to control soil pollution---** a) To reduce dependency on chemicals – Use of Bio fertilizers & Bio pesticides, Conservational Tillage, Mixed Cropping, Crop rotation, Biological Pest Mgmt., Organic Farming b) Bio / Phyto-remediation of contaminated sites. **Soil carbon Flux**	
4	**Forest Monitoring**	• **Classification of forests** • **Measurement of individual trees:** a. Measurement of diameter and girth of trees b. Measurement of heights of trees c. Measurement of form of trees d. Measurement of volume of felled trees e. Measurement of volume of standing trees f. Determination of age of trees • **Forest inventory** • **Kinds of sampling**, sampling units, sampling intensity	**08**
5.	**Noise Quality Parameters**	**Noise and Vibration Monitoring** • Measuring techniques for noise & vibration • Noise monitoring methods • The Basic Noise Unit; Lmax, SEL, Leq(h), Ldn, 24-Hour Exposure from All Events • **Noise Control Techniques-** Sound Insulation, Sound Absorption, Vibration Damping and Isolation • **Noise Control at Source—** a) Selection & Maintenance of machines. b) Control over vibrations. c) Installation of barriers / enclosures. d) Using protective equipment e) Noise proof walls	**08**

Semester I, Paper-III

Practical Course Based on EVS -231 & EVS- 232.

Sr. No.	Description	Practical Type	Practical Sessions
1.	Measurement of Primary Productivity of grassland by Harvest Method.	Field + Laboratory.	**01**
2.	Estimation of Total Chlorophyll from plants in Clean & Polluted Environment.	Laboratory.	**01**
3.	Study of grassland vegetation by List Count Quadrat Method to determine the Frequency, Density & Abundance.	Field + Laboratory	**01**
4.	Determination of Frequency & Abundance of species across terrestrial – aquatic transitional zone, by Line Transect Method.	Field + Laboratory	**01**
5.	Determination of Density of species across terrestrial – aquatic transitional zone by Belt Transect Method.	Field + Laboratory	**01**
6.	Field visit to study Watershed Mgmt. Techniques.	Visit.	**01**
7.	Visit to Nature Interpretation / Information Centre.	Visit.	**01**
8.	Visit to National Park / Wildlife Sanctuary to study Wildlife & various Inter-specific & Intra-specific Relations.	Visit.	**≥ 01 Day**
9.	Continuation of the use of Social Media for e-networking & dissemination of ideas on Environmental Issues Pertaining to the Course.	---	**≥ 02**
10.	Identification of advanced cultivars in the Local market	Visit.	**01**
11.	Field visit to study Rain water Harvesting technique	Visit.	**01**
12.	Determination of minimum area and number of quadrates for vegetation	Field + Laboratory	**01**
13.	Determination of Shannon Diversity Index of a vegetation (Data sheet)	Laboratory.	**01**
14.	Determination of Simpson Diversity Index of a vegetation (Data sheet)	Laboratory.	**01**
15.	Visit to Soil Survey Department.	Visit.	**01**
16.	Study of Soil sampling techniques	Visit.	**01**

Semester II, Paper-III

Practical Course Based on EVS -241 & EVS- 242.

Sr. No.	Description	Practical Type	Practical Sessions
1.	Sampling of Air by High Volume Sampler	Field + Laboratory	**01**
2.	Determination of Optimum Dose of Alum (Coagulant) required for water.	Laboratory.	**01**
3.	Determination of Turbidity of water. (Turbidimeter / Nephelometer)	Laboratory.	**01**
4.	Determination of Residual Chlorine from treated water.	Laboratory.	**01**
5.	Determination of Dissolved Oxygen in water by Winkler's method	Laboratory.	**01**
6.	Determination of Nitrate from water (Calorimeter)	Laboratory.	**01**
7.	Determination of Phosphate from water. (Colorimeter)	Laboratory.	**01**
8.	Determination of Soluble Salts from Soil.	Laboratory.	**01**
9.	Determination of Available Nitrogen from soil.	Laboratory.	**01**
10.	Study of Water Sampling and Preservation techniques	Field + Laboratory	**01**
11.	Measurement of sounds by DB meter / SLM in silent, industrial, residential and commercial zones and Analysis	Field + Laboratory	**01**
12.	Estimation of AGB, BGB and Carbon from sampling of trees	Field + Laboratory	**01**
13.	Determination of Lime required for Acidic soil	Laboratory	**01**
14.	Estimation of Productivity of Lake using DO method	Field + Laboratory	**02**
15.	Estimation of NOx content of given samples	Laboratory.	**01**
16.	Estimation of SOx content of given samples	Laboratory.	**01**

Reference Books

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- An Advanced Textbook on Biodiversity – Principles & Practice; Krishnamurthy K.V.; Oxford & IBH Publishing Co. Pvt. Ltd.; New Delhi.
- Ecology – Principles & Applications; Chapman J. L. & Reiss M. J.; Cambridge University Press.
- Fundamentals of Ecology; Odum P.E.; Natraj Publishers; Dehradun; 3 Edt..
- Ecology, Environment & Resource Conservation; Singh J.S., Singh S.P. & Gupta S.R.; Annamaya Publishers; New Delhi.
- Ecology & Environment; Sharma P.D.; Rastogi Publication; Meerut; 11 Rev. Edt..
- Environment Science; Tyler M.G.; Wadsworth Publishing Co.; 1997.
- Perspective in Environmental Studies; Kaushik & Kaushik; New Age International Pvt. Ltd. Publishers.
- Environmental Science; Santra S.C.; New Central Book Agency (P) Ltd.; 2 Edt..
- Environmental Chemistry, Dey A. K.; New Age International Publishers; 6 Edt..
- Air Pollution; Rao M.N. & Rao H.V.N.; Tata McGraw Hill; New Delhi; 1989.
- 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.
- Manual for Field Ecology; Mishra R.
- Handbook of Methods in Environmental Studies Vol-I &II; Mailti 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.
- Instrumental Methods of Analysis; Willard; cbpspd; 7 Edt..
- Pollution Management; Agarwal S.K.
- Waste Water Engineering, Treatment, Disposal & Reuse; Metcalf & Eddy
- Advanced Air and Noise Pollution Control – L.K Wang & N.C Pereira
- Textbook of Noise Pollution & Its Control – S.C. Bhatia
- Waste Water Engineering, Treatment, Disposal & Reuse; Metcalf & Eddy
- Environmental Pollution Control & Environmental Engineering; Rao C. S.; Tata McGraw Hill; New Delhi; 1994.
- Air Pollution; Rao M.N. & Rao H.V.N.; Tata McGraw Hill; New Delhi; 1989