

**Department of Environmental Science & Engineering**  
**Guru Jambheshwar University of Science & Technology,**  
**Hisar -125001**

<b>Name of M.Sc. Programme</b>	<b>Environnemental Sciences (w.e.f. 2017-2019)</b>
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**Distribution of Total Credits**

Program Core(PC)	Program Elective(PE)	Open Elective (OE)	Total Credits
79.5	16.5	4	100

**Semester-wise Schedule**

Semester-I					
S.N.	Course No.	Title	Type	L-T-P	Credits
1	EVS-511	Foundation of Environmental Science	PC	3-1-0	4
3	EVS-512	Ecology and Systems analysis	PC	3-1-0	4
4.	EVS-513	Natural Resources & Biodiversity	PC	3-1-0	4
5.	EVS-514	Environmental Chemistry	PC	3-1-0	4
6.	EVS-515	Lab-I(Ecology, Resources & Biodiversity)	PC	0-0-6	3
7.	EVS-516	Lab-II Environmental Chemistry	PC	0-0-6	3
<b>Total Credit</b>					<b>22</b>

**Semester-II**

1.	EVS-521	Physical Environment	PC	3-1-0	4
2.	EVS-522	Environmental Pollution	PC	3-1-0	4
3.	EVS-523	Instrumentation for Environmental Analysis	PC	3-1-0	4
4.	EVS-524	Environmental Microbiology	PC	3-1-0	4
5.	EVS-525	Biosystematics & Economic Botany	PE	3-1-0	4
6.	EVS-526	Environmental Geology	PE	3-1-0	4
7.	EVS-527	Environmental Modeling	PE	3-1-0	4
8.	EVS-528	Lab-III (Environmental Pollution)	PC	0-0-6	3
9.	EVS-529	Lab-IV (Environmental Microbiology)	PC	0-0-6	3
10.	EVS-530	Lab-V	PE	0-0-3	1.5
		(a) Bio Systematic & Economic Botany	PE	0-0-3	1.5
		(b) Environmental Geology	PE	0-0-3	1.5
		(c) Environmental Modeling			
<b>Total Credit</b>					<b>27.5</b>

**Semester-III**

1.	EVS-531	Environmental Biotechnology	PC	3-1-0	4
2.	EVS-532	Environmental Stress Physiology	PC	3-1-0	4
3.	EVS-533	Resource Conservation & Management	PE	3-1-0	4
4.	EVS-534	Agriculture & Environment	PE	3-1-0	4
5.	EVS-535	Natural Disasters	PE	3-1-0	4
6.	EVS-536	MOOC Courses (Available on SWAYAM website from time to time)	PE	3-1-0	4

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7	OE	Open Elective	PC	3-1-0	4
8	EVS-537	Lab-VI (Environmental Biotechnology)	PC	0-0-6	3
9	EVS-538	Lab-VII (Environmental Physiology)	PC	0-0-6	3
10	EVS-539	Lab-VIII Rural Technologies & Environment	PC	0-0-6	3
11	EVS-540	Summer Training (S/US)	PC	0-0-0	1
Total Credit					26

#### Semester-IV

1.	EVS-541	Pollution Management	PC	3-1-0	4
2.	EVS-542	Environmental Impact Assessment & Risk Analysis	PC	3-1-0	4
3.	EVS-543	Environmental Awareness & Law	PC	3-1-0	4
4.	EVS-544	Environmental Health & Toxicology	PE	3-1-0	4
5.	EVS-545	Ecotechnology	PE	3-1-0	4
6.	EVS-546	Solid Waste Management	PE	3-1-0	4
7.	EVS-547	Lab-IX (Industrial Pollution Management)	PC	0-0-6	3
8.	EVS-548	Lab-X (EIA & Health Risks)	PC	0-0-3	1.5
9	EVS-549	Lab-XI (a) Ecotechnology (b) Bioremediation (c) Solid Waste Management	PE PE PE	0-0-6 0-0-6 0-0-6	3 3 3
10	EVS-500	Credit Seminar	PC	0-0-0	1
Total Credit					24.5

- Note: (i) Summer training (4-5 weeks) to be undertaken at the end of IIInd semester.  
(ii) In IIInd Semester, students have the option to take one PE out of EVS-525/526/527 and corresponding one lab out of EVS-530 (a), (b) and (c).  
(iii) In IIIrd Semester, students have the option to take one PE out of EVS-533/534/535/536  
(iv) In IVth Semester, students have the option to take one PE (out of EVS-544/545/546) and one lab out EVS-549 (a), (b) and (c).

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For M.Sc. Students

**551(a) BASICS OF ENVIRONMENTAL SCIENCE**

**Credit 4(3-1-0)**  
**Maximum Marks: 100**  
**Internal Marks: 30**  
**External Marks: 70**  
**Time: 3 Hours**

**Note:** Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

**Unit-I**

Environment: Definition and scope; A brief account of Earth's life support system; hydrosphere, lithosphere, atmosphere, biosphere; concepts of carrying capacity, assimilative capacity, carbon and ecological footprint.

**Unit-II**

Major human cultural changes: agricultural and industrial revolution in relation to their environmental impacts, urbanization, urban sprawl and related environmental problems; concept of green-building, thermal, comfort and eco-cities, concept of sustainability principles and strategies of sustainable development.

**Unit-III**

Human population and environment: Historical and present global trends of population growth; human demography: Fertility, birth rates, mortality rates, life expectancy, doubling time, zero population growth, demographic transition (Case studies: China and India).

**Unit-IV**

Population explosion and related environmental problems, environmental consumerism, green consumerism, environmentalism, human-centric and earth centric views of development, National Environment Policy-salient features.

**Reference Books:**

- |                              |                    |
|------------------------------|--------------------|
| 1. Living in the Environment | : T.J. Miller      |
| 2. Understanding Environment | : Cunningham Saigo |

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551 (a) Basics of Environmental Science is Open Elective offered by the Department.

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The detailed Syllabus of the Scheme approved for the program w.e.f 2017-18 batch is attached. (P-9 to P-30)



## EVS-511 FOUNDATION OF ENVIRONMENTAL SCIENCE

Credit 4(4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Time: 3 Hours

### Note:

\* Eight questions will be set, four from each unit and the candidates will have to attempt five questions in all, selecting at least two from each unit. Each question will be of 14 marks.

### Unit-I

Environment: Definition and scope; A brief account of Earth's life support system; hydrosphere, lithosphere, atmosphere, biosphere; concepts of carrying capacity, assimilative capacity, carbon and ecological footprint.

### Unit-II

Major human cultural changes : agricultural and industrial revolution in relation to their environmental impacts, urbanization, urban sprawl and related environmental problems; concept of green-building, thermal, comfort and eco-cities, concept of sustainability principles and strategies of sustainable development.

### Unit-III

Human population and environment : Historical and present global trends of population growth; human demography : Fertility, birth rates, mortality rates, life expectancy, doubling time, zero population growth, demographic transition; population stabilization ( Case studies : China and India).

### Unit-IV

Population explosion and related environmental problems, environmental consumerism, green consumerism, environmentalism, human-centric and earth centric views of development; National Environment Policy – salient features.

### Reference Book:

- |    |                           |   |                  |
|----|---------------------------|---|------------------|
| 1. | Living in the Environment | : | T.J. Miller      |
| 2. | Understanding Environment | : | Cunningham Saigo |

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## EVS-512: ECOLOGY AND SYSTEMS ANALYSIS

Credit 4 (4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Time: 3 Hours

### Note:

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### Unit-I

**Introduction:** Aims and scope of ecology, Historical background; Ecology in India.

**Population ecology:** Characteristics, evolutionary strategies r and k selection; population growth. **Population Interaction:** Competition, Lotka-Volterra equations, mutualism, parasitism, predator prey relations.

### Unit-II

**Community Organization:** Analytic and synthetic characters, concept of niche, keystone species, ecotypes, plant indicators. **Ecological Succession:** Types, trends and models, concept of climax.

### Unit-III

**Ecosystem:** Structural components, ecological pyramids, food webs, trophic levels, ecological efficiencies, models of energy flow, primary and secondary production, methods of measuring primary productivity, biogeochemical cycles, gaseous and sedimentary cycles-carbon cycle, nitrogen cycle, sulphur cycle and phosphorus cycle.

### Unit-IV

**Ecosystem stability:** Species diversity, Stability, Cybernetics and ecosystem regulation.

**Systems Analysis:** Systems theory, ecological models-characteristics and applications, compartment model, matrix model, statistical model, mathematical model, energy-circuit analog language.

### Reference Books:

1. Basic Ecology- E.P.Odum
2. Ecology & Field Biology-R.L.Smith
3. Fundamentals of Ecology- E.P. Odum
4. Principles of Ecology-Rickleffs

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## EVS-513: NATURAL RESOURCES AND BIODIVERSITY

Credit 4 (4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Time: 3 Hours

### Note:

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### Unit-I

**Physical Resources:** Renewable & non-renewable resources. Soil resources: soil type, soil profile and soil erosion. Water resources: Surface water, ground water, hydrological cycle. Mineral resources: Types, their characteristics & uses, minerals from the sea.

### Unit-II

**Energy resources:** Fossil fuels, nuclear energy, solar energy, wind energy, tidal energy, geothermal energy, hydropower. Hydrogen as a source of energy, energy from biomass, bioconversion technology, energy plantations and petro-crops. Environmental impacts of various forms of energy use.

### Unit-III

**Biological resources:** forests, their importance, types, primary and secondary products - value & uses, forest resources of India. Wild-life of India. Range lands: Types, significance, range lands in India. Convention on biodiversity.

### Unit-IV

**Biodiversity :** Definition; Historical and geographical causes for diversity; Types of diversity; threats to biodiversity and species extinction, threatened and endangered species, hot spots of biodiversity, biodiversity conservation strategies - in situ and ex situ conservation ; National wilderness areas, biosphere reserves, gene banks, germ plasma Banks,

### Reference Books:

1. Natural Resources conservation-Oliver S Owen & Chiras
2. Living in the Environment -T.J.Miller
3. Environmental Science- Cunningham Saigo
4. Ecology of Natural Resources-Ramade,
5. Global Biodiversity-W.R.L. IUCN
6. Soils-Miller, W & R.L. Donhau

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## **EVS-514: ENVIRONMENTAL CHEMISTRY**

**Credit 4 (4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

**Thermodynamics:** First law of thermodynamics, enthalpy, adiabatic transformations, second law of thermodynamics, Carnot's cycle, entropy, Gibb's free energy, chemical potential, phase equilibria, Gibb's Donnan equilibrium, third law of thermodynamics, enzyme catalysis, Michaelis-Menten equation.

### **Unit-II**

**Atmospheric Chemistry :** Chemical composition of atmosphere-particles, ions and radicals, formation of particulate matter, Photo-chemical and chemical reactions in the atmosphere, smog, acid rain, chemistry of ozone layer depletion.

### **Unit-III**

**Soil Chemistry :** Weathering of rocks, Soil profile, Inorganic and organic components of soils, Major rock forming minerals, Soil /normal forming factors, Soil properties, Chemical and mineralogical properties of soils.

### **Unit-IV**

**Water Chemistry :** Water quality parameters, standards, chemistry of inland water bodies like lakes, streams, rivers estuaries and wetlands, solubility of gases in water, carbonate system, redox potential.

### **Reference Books:**

1. Environmental Chemistry-Mannahan
2. Fundamentals of Soil Science-Henry D. Futh
3. Text book of Limnology-G.A.Cole
4. Environmental Chemistry-Sharma & Kaur

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## EVS-521: PHYSICAL ENVIRONMENT

Credit 4(4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Times: 3 Hours

### Note:

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### Unit-I

**Atmospheric Environment:** Composition of atmosphere, vertical distribution of temperature in atmosphere, relationship of earth with sun, heat budget of the earth-atmospheric system, scales of meteorology, hydrostatic equilibrium, various kinds of lapse rates, vertical stability of atmosphere, cloud classification and formation, winds, wind roses, Coriolis force, global pressure belt system, monsoons, El nino.

### Unit-II

**Aquatic Environment :** Global water balance. Ice sheets and fluctuations of sea levels. Origin and composition of sea water. Hydrological cycle. Inland water bodies like lakes, streams, rivers, estuaries and wetlands.

### Unit-III

**Terrestrial Environment:** Igneous, sedimentary and metamorphic rocks, weathering, erosion, transportation and deposition of earth's material by running water, wind, glaciers. The land use plan, soil surveys in relation to land use planning, methods of site selection and evaluation.

### Unit-IV

**Global climate change:** History of climate change, Milankovitch's theory of climate change, greenhouse gases and their effects, role of humans, climatic feedback mechanisms, possible impacts of global climate change.

### Reference Books:

1. The atmosphere : An introduction- F.K. Lutgens
2. Atmospheric Science Wallace & Hobbs
3. Confronting Climate change- I.M. Mintzer
4. Atmosphere, weather & Climate- Navarra
5. Earth Science : A holistic approach- Conti, Thompson and Moses
6. Oceanography- Grand Gross
7. Oceanography: An introduction to the Marine Environment- Richard A. Davis.

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## **EVS -522: ENVIRONMENTAL POLLUTION**

**Credit 4(4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

**Water Pollution :** Sources, consequences, ecological and biochemical aspects of water pollution, characteristics of domestic, industrial and agricultural wastes, their effects on water bodies, chemical and bacteriological sampling and analysis, water quality parameters, criteria and standards. Marine pollution: thermal pollution.

### **Unit-II**

**Soil Pollution:** Soil pollution from use of fertilizers, pesticides, heavy metals, waste disposal, industrial effluents and surfactants. Detrimental effects of soil pollutants, Remedial measures for soil pollution, soil sediments as pollutant. Chemical methods of soil analysis- sample preparation and soil analysis. Radioactive pollution.

### **Unit-III**

**Air Pollution:** Sources, classification and properties of air pollutants, behaviour and fate of air pollutants, effects of air pollution on human health & materials, sampling and analysis of air pollutants, SO<sub>x</sub>, NO<sub>x</sub>, CO, Ozone, hydrocarbons and particulate matter, meteorological aspects of air pollutant dispersion, air quality.

### **Unit-IV**

**Noise Pollution :** definition, sound pressure level, noise-spectra-octave bands, combining decibels, frequency weighting net-works, noise-monitoring-sound levelmeter, equivalent continuous noise level and other noise indices. Effects of noise pollution.

### **Reference Books :**

1. Industrial Noise Control- Bell & Bell
2. Introduction to Environmental engineering & Science- Gilbert Masters
3. Geo-environment- An Introduction – V. Aswathanarayan
4. Soil Chemistry- Bolt & Buggenwert.

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## EVS-523: INSTRUMENTATION FOR ENVIRONMENTAL ANALYSIS

Credit 4 (4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Time: 3 Hours

### Note:

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### Unit-I

Method of collection of Air, Water & Soil samples. Principles working and applications of Spectrophotometry (UV-Visible spectrophotometry, flame photometry, Atomic Absorption spectrophotometry).

### Unit-II

Principles, working and applications of X-Ray diffraction, Colorimetry and polarimetry, Fluorometry.

### Unit-III

Principles, working and applications of Microscopy-Phase contrast, fluorescent, polarization, SEM.

### Unit-IV

Principles, working and applications of Chromatographic techniques (Paper chromatography, thin layer chromatography, Gas liquid chromatography, High pressure liquid chromatography, Ion exchange chromatography, Column chromatography),

### Reference Books :

1. Undergraduates Instrumental Analysis- James W. Robinson
2. Modern methods of Chemical analysis- Robert, Shields, Cairns, William.

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## EVS-524 ENVIRONMENTAL MICROBIOLOGY

Credits 4 (4-0-0)  
Maximum Marks: 100  
Internal Marks: 30  
External Marks: 70  
Time: 3 Hours

### Note:

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### Unit-I

**Aquatic Microbiology:** Microbes in aquatic systems, Measuring activity of microbes in water, Pathogens in water, Water health standards, bio-films.

### Unit-II

**Soil microbiology:** Microbes in soils and their role, microbial interactions, mineralization and immobilization of nutrients in soil, Microbial degradation of cellulose, lignin Microbe mediated C, N and S transformations mycorrhiza and their environmental significance.

### Unit-III

**Biodegradation microbiology:** Interaction of biological, chemical and environmental factors in Biodegradation processes. Bioremediation processes; Definition and classification including *in situ* and *ex situ* types.

### Unit-IV

**Applied Environmental Microbiology:** Biodegradation of pesticides and hydrocarbons, Sewage sludge treatment using microbes, microbial fermentations, biohydrometallurgy and microbial recovery of oil.

### Reference Books:

1. Microbiology- J.G. Black
2. Microbial Biotechnology-A.N. Glazer
3. Microbial Ecology- R.M. Atlas & Bartha
4. Microbiology- Pelczar
5. Introduction to Environmental Microbiology - Barbara Kolwzan, Waldemar Adamiak, Kazimierz Grabas and Adam Pawelczyk

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## **EVS-525: BIO SYSTEMATICS & ECONOMIC BOTANY**

**Credits 4 (4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

**Biosystematics:** Introduction of taxonomy, General account and diagnostic features of the following families (excluding economic importance): Ranunculaceae, Cruciferae, Umbelliferae, Compositae, Poaceae

### **Unit-II**

**Economic Botany:** Origin, Cultivation, Harvesting techniques of wheat, rice & maize and their important varieties; Pulses and Legumes.

### **Unit-III**

**Economy Botany:** Sugar producing plants; Oil yielding plants; Medicinal Plants, Latex and rubber yielding plants.

### **Unit-IV**

Timber Yielding Plants – Teak, Shisham; Spices and Condiments-Ginger, Turmeric, Garlic, Coriander, Cardamom, Cinnamon, Asafoetida; beverages – tea, coffee.

### **References:**

1. Economic Botany-Scherry
2. Plant taxonomy-Subramaniam

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## **EVS-526: ENVIRONMENTAL GEOLOGY**

**Credit 4 (4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit- I Introduction to Geology**

Geology as a discipline, Special problems of time and scale in geology, Complexity in natural systems, Geology and the Scientific method. Key concepts in the history of geology. Concept of Geologic Time-Relative dating, absolute dating, the Geological time scale, Basic concepts of plate tectonics- evidences for continental drift, type of plate boundaries, plate tectonics and rock cycle.

### **Unit-II Environmental Geochemistry**

Concept of major, trace and Rare Earth elements (REE) elements. Bio-geochemical cycles (N, C, S and P). Classification of trace elements, trace elements and health. Possible impacts of imbalance of some trace elements.

### **Unit-III Mineral resources and environment**

Resources and reserves, minerals and population. Igneous, sedimentary, metamorphic, biological processes associated with formation of mineral deposits. Oceans as new areas for exploration of mineral resources. Environmental impacts of fossil fuels use. Recycling of resources.

### **Unit-IV Geobiology**

Geobiology/geomicrobiology and its applications, Composition of the early earth atmosphere and evolution of present day atmosphere, Life before oxygen, Concept of biomineralization, characteristics of biominerals, biologically induced and biologically controlled biomineralisation processes.

### **Reference Books:**

1. Environmental geology by Edward A.Keller
2. Physical geology by C.W. Montgomery

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## **EVS-527: ENVIRONMENTAL MODELING**

**Credit 4 (4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

Role of modeling in environmental sciences, model classification deterministic models, stochastic models, steady state models, dynamic models.

### **Unit-II**

Different stages involved in model building. Methods for the formulation of dynamic balance equations-mass balance procedures, energy balancing, simple microbial growth kinetics, Monod equation.

### **Unit-III**

Simulation examples- Streeter-Phelps Oxygen Sag Model, Lotka-Volterra Predator Prey Model.

### **Unit-IV**

GIS-Principle, Scope, Methodology and role in environmental modeling and management

### **Reference Books:**

1. Dynamics of Environmental Bioprocesses- Modeling & Simulation – Snape & Dunn
2. Environmental Modelling- Jorgensen

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EVS-532: ENVIRONMENTAL BIOTECHNOLOGY

Credits 4(4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Time: 3 Hours

**Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

**Unit-I**

**Basic Techniques in genetic engineering:** Restriction endonucleases, Restriction analysis, Southern blotting and hybridization, Gene identification and isolation; Genomic library, Use of reverse- transcriptase, c DNA library construction and screening.

**Unit-II**

Introduction of cloned genes into new hosts using plasmid and phage vector systems, Chemical synthesis of DNA, DNA ligation, Transformation and screening of transformations, Expression of genes in new host.

**Unit-III**

Gene transfer methods in bacteria and plants, Polymerase chain reaction, DNA sequencing methods, Hybridoma Technology, ELISA .

**Unit-IV**

**Applications** of natural and genetically engineered micro-organisms from extreme environment: like thermophiles, alkalophiles; acidophiles, and halophiles in waste treatment of different industries. Production of enzymes like cellulase, proteases amylases; alcohol and acetic acid production, Petroleum pollutant biodegradation.

**Reference Books:**

1. Gene V – Levine
2. Environmental Biotechnology, Concepts and Applications. Hans-Joachim Jordening and Josef Winter. Winter-VCH. 2005
3. Biology of wastewater Treatment. N F Gray. Mc Graw Hill . 2004.
4. An Introduction to Environmental Biotechnology by Milton Wain Wright. Kluwer Acad Publ. Group, Springer, 1999.
5. Environmental Biotechnology – Sayler.& Fox
6. Principles of Gene Manipulation. 6th Edition, S.B.University Press, 2001- S.B. Primrose, R.M. Twyman and R.W.Old

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EVS-533: ENVIRONMENTAL STRESS PHYSIOLOGY

Credits 4(4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Time: 3 Hours

**Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

**Unit-I**

**Plant responses to physical environment:** Concept of stress and strain, Plant responses to UV radiations, high temperature and low temperature stress, water stress responses and adaptations to drought and flooding, desiccation tolerance.

**Unit-II**

**Plant responses to chemical environment:** Responses of halophytes and non-halophytes to salt stress, ionic regulation and osmo-regulation, salt tolerance, metal toxicity and metal tolerance, plant responses to air pollutions SO<sub>x</sub>, NO<sub>x</sub>, ozone.

**Unit-III**

**Photosynthetic responses:** Plant responses to enriched CO<sub>2</sub> environment, ecological significance of different CO<sub>2</sub> fixation pathways, modeling photosynthetic responses to environment, Circadian rhythms and biological clock.

**Unit-IV**

**Animal response to environmental stress:** Osmoregulation in fish, water conservation in desert animals; hibernation and aestivation, animal responses to high altitude and deep sea environment.

**Reference Books:**

1. Physiological Plant Ecology- Encyclopedia ( Vol.I-IV) Springer Verlag
2. Plant Physiology- Salisbury & Ross
3. Plant Ecophysiology – Prasad
4. Adaptive Animal Physiology – Nelson Schmidt.

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533  
EVS -531: RESOURCE CONSERVATION & MANAGEMENT

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Credits 4(4-0-0)  
Maximum Marks: 100  
Internal Marks: 30  
External Marks: 70  
Time: 3 Hours

**Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

**Unit-I**

**Conservation:** Principles of resource conservation, harvesting models, World conservation Strategy, IUCN, International Geosphere-Biosphere Programme.

**Unit-II**

**Biological Resource Management :** Management of forests, effects of deforestation, desertification, range management, management of wetlands and fresh water ecosystems, wildlife management, conservation efforts for threatened species in India, CITES.

**Unit-III**

**Physical Resource Management:** Water management; management of watersheds, Recovery of eutrophicated lakes, rehabilitation of polluted rivers-Ganga Action Plan, Yamuna Action Plan ; Rain water harvesting; Soil conservation ; wasteland problems, reclamation & management of wastelands with special reference to India.

**Unit-IV**

**Energy Management:** Energy conservation strategies, Bioenergy-Prospects in India.

**Remote Sensing :** Principles of remote sensing, Photointerpretation, Applications of remote sensing and GIS in environmental management.

**Reference Books:**

1. Conservation Ecology –G.W.Cox
2. Restoration of degraded lands (Ed.) –J.S. Singh
3. Natural Resource Conservation-Owen & Chiras
4. Biotechnological Environmental Management – Biotol series
5. Introduction to Environmental Remote Sensing – Curtis

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## **EVS-534: AGRICULTURE AND ENVIRONMENT**

**Credits 4(4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

**Agricultural Practices:** Sustainable agriculture, organic farming, dry-land farming, zero tillage, agro-forestry, social forestry irrigation practices, water logging and secondary salinization, environmental impacts of irrigation projects.

### **Unit-II**

**Crop Protection:** Pesticides: Classification, pesticide resistance; biological & ecological pest control, Integrated Pest management, Pesticide safety.

### **Unit-III**

**Crop Production:** Bio-fertilizers, vermicomposting, allelopathy., Biotechnological innovations in crop protection.

### **Unit-IV**

**Weather & crop productivity:** Impact of global warming on agriculture and food security; Green-Revolution- environmental implications, NPK fertilizers and their environmental effects.

### **Reference Books :**

1. Sustainable Agriculture – H.R. Sharma
2. Global Climate Change – Pary Martin
3. Allelopathy – S.S. Narwal
4. Environmental Chemistry – Mannahan
5. Soils – Miller and Donhau
6. Environment and Agriculture – Dhaliwal, Jairath and Hansra

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## EVS- 535: NATURAL DISASTERS

Credits 4 (4-0-0)  
Maximum Marks: 100  
Internal Marks: 30  
External Marks: 70  
Time: 3 Hours

### Note:

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### Unit-I Introduction to Hazards

Hazard Classification – Natural hazards and Technological hazards, Effects of hazards, Vulnerability and susceptibility of hazards, Assessing hazards and risks, Hazard prediction and warning, Role of different individuals, Natural Service functions of natural hazards. A brief introduction to biological hazards- Forest fires, Biological warfare, Anthrax.

### Unit-II Earthquakes and Volcanoes

Earthquakes - Types and Distribution of earthquakes, Prediction and control of earthquakes, Tsunami - Hazards associated with tsunamis, Tsunami prediction and warning systems,

Volcanoes-Distribution of volcanoes, eruption processes, Kinds of volcanic eruptions, Factors controlling volcanic eruptions, Products of volcanic eruptions, Hazards associated with volcanoes.

### Unit-III Floods and Landslides

Different kinds of floods, Factors leading to floods, Factors affecting floods, Floods and their associated hazards, Flood control measures, Prediction of floods.

Factors causing landslides, Different kinds of mass movements, Factors that affect mass movement, prediction of mass movement, Landslides and their effects, Precursor events before the occurrence of landslides, Prevention and mitigation of mass movements.

### Unit- IV Weather related Hazards

Effects of cyclones, genesis of a cyclone, Behaviour of a cyclone and their forecast, Factors affecting cyclone hazards, Structure of a tropical cyclone, Size of tropical cyclones, Cyclone risk and mitigation strategies, Storm surge, Hurricane, cyclones and tornadoes, thunderstorms, lightning, Service functions of thunderstorms and lightning.

Factors leading to drought, drought consequences, strategies for drought mitigation, Desertification – Factors causing desertification, famine, El Nino and their effects.

### Reference Books:

1. Environmental geology by Edward A. Keller
2. Physical geology by C.W. Montgomery

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## **EVS-541: POLLUTION MANAGEMENT**

**Credits 4(4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

**Note: -**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

**Waste water management:** Primary treatment methods – screening, grit removal, primary sedimentation, secondary treatment methods, Activated sludge process, trickling filters, rotating biological contactors, oxidation ponds and lagoons. Advance waste water treatment-removal of nutrients and solids. Waste water reuse and sludge disposal, MINAS

### **Unit-II**

**Air Pollution control:** Control methods for particulates-gravitational settling chambers, Centrifugal collectors, Wet collectors, Fabric filters, electro static precipitators. Control methods for gaseous pollutants- adsorption, absorption, condensation, combustion.

### **Unit-III**

**Noise Pollution Control:** Absorbing materials, barrier materials, damping materials, acoustical enclosures, Reactive silencers and filters; Active noise control methods.

### **Unit-IV**

**Solid Waste Management:** Sources & generation of solid waste, their characterization, Methods of disposal.

### **Reference Books:**

1. Environmental Engineering – Peary
2. Introduction to Environmental Engineering and Science – Gilbert Masters
3. Air Pollution and Control – K.V.S.G. Murlikrishnan
4. Industrial Noise Control – Bell & Bell

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## **EVS-542: ENVIRONMENTAL IMPACT ASSESSMENT AND RISK ANALYSIS**

**Credits 4(4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

**EIA:** Origin, goals, principles and significance; Regulatory bodies, Concept of rapid and comprehensive EIA, Cumulative EIA, Strategic Environmental Assessment (SEA) – Principles and process; EIA notification (MOEF) 1994, 2006; Steps of EIA; Screening and scoping; Acquisition of base line data, its importance.

### **Unit-II**

Impact Identification methods, impact prediction, models of prediction.

Impact evaluation – Cost benefit analysis, methods of monetary evaluation of environmental parameters, multi-criteria approach.

Mitigation of impacts – approaches and methods in relation to different development projects.

### **Unit-III**

Public participation in EIA, presentation and review process, methods and role of monitoring in EIA, Environmental auditing, Environmental Management Plan, Principles of Environmental Management System; ISO 14000.

Risk analysis: definition; risk characterization and methods of risk assessment.

### **Unit-IV**

Environmental Impacts of mining industry, nuclear and thermal power plant, textile industry, paper and pulp industry.

EIA of a dam (one case study)

Environmental clearance of buildings: MOEF guidelines.

### **Reference Books:**

1. Environmental Impact Assessment – John Glasson
2. Methods of Environmental Impact Assessment – Morris & Therivel
3. Environmental Impact Assessment – L.W. Canter
4. Chemical Principles of Environmental Pollution – Alloway & Ayers
5. Industrial Environment – Assessment and Strategy – S.K. Aggarwal
6. Introduction to Environmental Engineering and Science – Gilbert Masters
7. Handbook of Environmental Assessment, (Vol.-I & II) – Judith Petts

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## **EVS-543: ENVIRONMENTAL AWARENESS AND LEGISLATION**

**Credits 4(4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

**Environmental awareness approaches:** Role of media in environmental awareness, role of NGOs in environmental movements, Chipko movement, Appiko movement, Ecomark scheme, Sustainable Development.

### **Unit-II**

**International environmental initiatives:** The Stockholm Declaration, Earth Summit, Convention on protection of environment, Ramsar convention on wetlands, Outer space treaty, Vienna convention & Montreal Protocol, Kyoto Protocol.

### **Unit-III**

Pollution control through legislation in India with special reference to the Water Prevention and Control of Pollution) Act, 1974; The Air (Prevention and Control of Pollution) Act, 1981; The Environmental Protection Act, 1986, Forest & Wild Life Act.

### **Unit-IV**

Principles of Guru Jambheshwar Ji Maharaj, Movements for tree preservation

### **Reference Books:**

1. Economics and Environment – Good Steie
2. Environmental Planning, Policies & Programmes in India – K.D. Saxena
3. Land – Use and Environment – S.M. Mujtava
4. Environmental Administration and Law- Paras Diwan.

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## EVS-544: ENVIRONMENTAL HEALTH AND TOXICOLOGY

Credits 4 (4-0-0)

Maximum Marks: 100

Internal Marks: 30

External Marks: 70

Time: 3 Hours

### Note:

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### Unit-I

**Pollution and human health:** Trace element deficiency and disorders, occupational health hazards, biogeochemical factors in environmental health, epidemiological issues- goiter, fluorosis, arsenic poisoning.

### Unit-II

**Transmissible diseases:** Symptoms, epidemiology and control of vector borne diseases- amoebiasis, trypanosomiasis, filariasis, leishmaniasis, schistosomiasis, life cycle of Plasmodium, control of Malaria, tuberculosis and AIDS. Waterborne diseases: Jaundice & diarrhea.

### Unit-III

**Principles of toxicology:** Toxic chemicals in the environment and their effects, heavy metals, Pesticides. Mode of entry of toxic substances, biotransformation of xenobiotics, detoxification, indices of toxicology.

### Unit-IV

**Genetic Toxicology:** Carcinogenesis; Carcinogens, chemical carcinogenicity, mechanism of carcinogenicity, Oncogenes and tumour suppressor genes. Environmental carcinogenicity testing. Mutagens, Environmental mutagen testing- Bacterial mutagenesis assays, gene mutation chromosome damage assays, DNA damage and repair assays.

### Reference Books:

1. Environmental Hazards and Human Health – R.B. Phillip
2. Toxicology – Principles and Applications- Niesink, John de Vries & Holligner
3. Progress in predictive toxicology- Clayson, Munro, Shubik & Swenberg (eds.)
- Parasitology- Chatterjee
4. Parasitology - Chatterjee
5. Preventive and Social Medicine- Perk

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## **EVS-545: ECOTECHNOLOGY**

**Credits 4(4-0-0)**  
**Maximum Marks: 100**  
**Internal Marks: 30**  
**External Marks: 70**  
**Time: 3 Hours**

### **Note:**

Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each question will be of 14 marks.

### **Unit-I**

Basic concepts of ecosystem dynamics, eco-designing, ecotechnological approaches, applications of ecotechnology for societal welfare and sustainable development.

### **Unit-II**

Wetland ecosystems-ecological significance, natural purifying potential, Constructed wetlands-their design, structure, functioning, Applications.

### **Unit-III**

Decontamination of polluted sites-phytoremediation technology, phytostabilisation, phytovolatilisation; Bioremediation of waste waters.

### **Unit-IV**

Restoration of degraded ecosystems using ecological approach: mined areas and waste lands

Building resilience of ecosystems- soil fertility management.

### **References:**

1. Mitsch, W.J. and Jorgensen, S.E. 1989. Ecological Engineering: An Introduction to Ecotechnology John Wiley & Sons, New York.
2. Kadlec, R.H., Knight, R.L. 1986. Treatment Wetlands Lewis Publishers, Boca Raton, FL.

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## EVS-546: Solid Waste Management

**Credit 4(4-0-0)**

**Maximum Marks: 100**

**Internal Marks: 30**

**External Marks: 70**

**Time: 3 Hours**

**Note:**

**Nine questions will be set by the examiners, two from each unit and one question of short answer/objective type covering the whole syllabus, which will be compulsory. Students will have to attempt five questions in all, including one question from each unit and the compulsory question. Each questions will be of 10 marks.**

## Unit-I

**Solid wastes:** Sources and classification of solid wastes, Solid waste management options: Sanitary Landfill, Recycling, Composting, Incineration, Energy recovery options from organic wastes.

## Unit-II

**Solid waste management plan, Municipal Solid Waste (Management and Handling) Rules, 2000**

Hospital waste management, Biomedical Waste (Management and Handling) Rules, 1988

### Unit-III

**Fly ash management**, Fly ash Management Rules, (1999) Hazardous waste management: Sources and classification, Hazard communication,

## Unit-IV

**Hazardous Waste Management:** Physico-chemical properties of hazardous waste needed in management., Hazardous waste control, treatment and management, Hazardous Waste (Management and Handling) Rules (1989) and (2000) Amendments

### References:

1. Solid Waste Management Manual CPCB, New Delhi
2. Ecotechnology for Pollution Control and Environmental Management by Trivedy R.K. and Arvind Kumar
3. Basic Environmental Technology Nathanson, J.A.

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