Dr. BABASAHEB AMBEDKAR MARATHWADA UNIVERSITY,
CHHATRAPATI SAMBHAJINAGAR.

NAAC- 'A $^{+}$' Grade

CIRCULAR NO.SU/ Sci./College/NEP-2020/73/2025

It is hereby inform to all concerned that, the syllabi prepared by the Board of Studies/ Ad-hoc Boards/Committee and recommended by the Dean, Faculty of Science & Technology, the Academic Council at its meeting held on 09 May 2025 has been accepted **the following B.Sc. Course Structure & Curriculum** under the Faculty of Science & Technology as per National Education Policy – 2020 run at the Affiliated Colleges of Dr. Babasaheb Ambedkar Marathwada University as appended herewith.

Sr.No.	Courses	Semester
1	B.Sc. Physics	IIIrd and IVth Semester
2	B.Sc. Electronics	IIIrd and IVth Semester
3	B.Sc. Mathematics	IIIrd and IVth Semester
4	B.Sc. Industrial Chemistry	IIIrd and IVth Semester
5	B.Sc. Agrochemical and Fertilize	IIIrd and IVth Semester
6	B.Sc. Horticulture	IIIrd and IVth Semester
7	B.Sc. Biochemistry	IIIrd and IVth Semester
8	B.Sc. Botany	IIIrd and IVth Semester
9	B.Sc. Zoology	IIIrd and IVth Semester
10	B.Sc. Biotechnology	IIIrd and IVth Semester
11	B.Sc. Microbiology	IIIrd and IVth Semester
12	B.Sc. Diary Science and Technology	IIIrd and IVth Semester
13	B.Sc. Statistics	IIIrd and IVth Semester
14	B.Sc. Computer Science	IIIrd and IVth Semester
15	B.Sc. Geology	IIIrd and IVth Semester
16	B.Sc. Chemistry	IIIrd and IVth Semester
17	B.Sc. Analytical Chemistry	IIIrd and IVth Semester
18	B.Sc. Polymer Chemistry	IIIrd and IVth Semester
19	B.Sc. Environmental Science	IIIrd and IVth Semester
20.	B.Sc. Fisheries Science	IIIrd and IVth Semester

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21.	B.Sc. Home Science	IIIrd and IVth Semester
22.	B.Sc. Data Science	IIIrd and IVth Semester
23.	B.Sc. Information Technology	IIIrd and IVth Semester
24.	B.Sc. Networking and Multimedia	IIIrd and IVth Semester
25.	B.Sc. Automobile Technology	IIIrd and IVth Semester
26.	B.Sc. Forensic Science	IIIrd and IVth Semester
27.	B.Sc. Forensic Science & Cyber Security	IIIrd and IVth Semester
28.	B.Sc. Non-Conventional & Conventional Energy	IIIrd and IVth Semester
29.	B.Sc. Clinical Laboratory Science	IIIrd and IVth Semester
30.	Bachelor of Computer Application	IIIrd and IVth Semester

This is effective from the Academic Year 2025-26 and onwards.

All concerned are requested to note the contents of this circular and bring the notice to the students, teachers and staff for their information and necessary action.

University Campus,
Chhatrapati Sambhajinagar
-431 004.
Ref.No. SU/Sci./2025/827-29
Date:- 26/05/2025

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Deputy Registrar,
Syllabus Section.

Copy forwarded and necessary action to :-

1] **The Principal of all Affiliated Colleges,**
Dr. Babasaheb Ambedkar Marathwada University,

2] **The Director, University Network & Information Centre, UNIC, with a request to upload this Circular on University Website.**

Copy to :-

1] The Director, Board of Examinations & Evaluation, Dr.Babasaheb Ambedkar Marathwada University, Chhatrapati Sambhajinagar.

JD*26052025/-

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Dr. Babasaheb Ambedkar Marathwada University

Chhatrapati Sambhajinagar- 431001

Course Structure

for

B. Sc. Environmental Sciences (Second year)

(AS PER NEP-2020)

1/7/2025

Effective from 2025-26

PRINCIPAL
S.B.E.S. College of Science
Chh. Sambhajinagar

chairman,
Ad-hoc Board in
Environmental Sci

Class: B.Sc. Second Year Semester: III[rd]; Subject: Environmental Science

Students will have to select / declare choice of **one major subject** and **one minor subject** from three major options M1, M2 and M3 (which were opted in the first year)

Course Type	Course Code	Examination Code (To be given by respective BoS)	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	**ENS/DSC/T/200**	**SAC03292003T**	**Environmental Plan, Policies & Legislation**	2		2		2+2+2+2 = 08
	ENS/DSC/T/201	**SAC0329 2013T**	**Environmental Instrumentation &Analysis**	2		2		
	ENS/DSC/P/ 226	**SAC03292063P**	**Practical based on ENS/DSC/T/200**		4		2	
	ENS/DSC/P/ 227	**SAC03292073P**	**Practical based onENS/DSC/T/201**		4		2	
Minor (Choose any two from pool of courses) **It is from different discipline of same faculty**	**ENS/Mn/T/ 200**	**SCC03292003T**	**Application of Environmental Biotechnology in Agriculture**	2		2		2+2 = 04
	ENS/Mn/T/ 201	**SCC03292013T**	**Classification & Quantification of Major Air, Water, & Soil Pollutants**	2		2		
Generic / Open Elective (GE/OE) (Choose any one from pool of courses)	**ENS/GE/OE/T/200** **ENS/GE/OE/T/201**	**SDC03292003T** **SDC032092013T**	**Environmental Meteorology & Geological Hazards** **Environmental Sustainability Issues in Industries**	2		2		02
VSC (Vocational Skill Courses) (Choose any one from ENS/VSC/T/ 200 and ENS/VSC/T/ 201) and corresponding Practicals	**ENS/VSC/T/ 200**	**SEC03292003T**	**Socioeconomic Aspects of Environment**	1		1		1+1 =02
	ENS/VSC/T/ 201	**SEC03292013T**	**Man & Wildlife Conflict**	1		1		
	ENS/VSC/P/ 226	**SEC03292063P**	**Practicals based on ENS/VSC/T/ 200**		2		1	
	ENS/VSC/P/ 227	**SEC03292073P**	**Practicals based on ENS/VSC/T/ 201**		2		1	
AEC, VEC, IKS			**English** (Common for all the faculty)	2		2		2 + 2 = 04
	ENS/VEC/T/201		Environmental Studies	2		2		
OJT/ FP/CEP/CC/RP			Cultural Activity / NSS,NCC (Common for all the faculty)		4		2	02
				15	**14**	**15**	**07**	**22**

Minor Courses for other Discipline

ENS/Mn/T/ 200 : This is a 2 credit theory course to be designed for other discipline

ENS/Mn/T/ 201 : This is a 2 credit theory course to be designed for other discipline

Generic /Open Elective Courses for other faculty

ENS/GE/OE/T/200 : This is a 2 credit theory course to be designed for other faculty

Class: B.Sc. Second Year Semester: IVth; Subject: Environmental Science

Course Type	Course Code	Examination Code (To be given by respective BoS)	Course Name	Teaching Scheme (Hrs / Week)		Credits Assigned		Total Credits
				Theory	Practical	Theory	Practical	
Major (Core) Mandatory DSC	**ENS/DSC/T/250**	**SAC03292504T**	Biogeographic & Physiographic Zones of India	**2**		**2**		**2+2+2+2 = 08**
	ENS/DSC/T/ 251	**SAC03292514T**	Groundwater Engineering & Watershed Management	2		2		
	ENS/DSC/P/ 276	**SAC03292564P**	Practical based on ENS/DSC/T/250		4		2	
	ENS/DSC/P/ 277	**SAC03292574P**	Practical based on ENS/DSC/T/ 251		4		2	
Minor (Choose any two from pool of courses) **It is from different discipline of the same faculty**	**ENS/Mn/T/250**	**SCC03292504T**	Energy Resource Management & Green Initiatives	2		2		2+2 = 04
	ENS/Mn/T/ 251	**SCC03292514T**	Emerging Technologies for Treatment of Waste Water	2		2		
Generic / Open Elective (GE/OE) (Choose any one from pool of courses)	**ENS/GE/OE/T/250** **ENS/GE/OE/T/251**	**SDC03292504T** **SDC03292514T**	Environmental Statistics & Computer Application Industrial Safety & Health Hygiene	2		2		02
SEC (Skill Enhancement Courses) (Choose any one from ENS/SEC/T/250and ENS/SEC/T/ 251) and corresponding Practicals	**ENS/SEC/T/250**	**SEC03292504T**	Mineral Resource Management	1		1		1+1 =02
	ENS/SEC/T/ 251	**SEC03292514T**	Environmental Tourism	1		1		
	ENS/SEC/P/ 276	**SEC03292564P**	Practicals based on ENS/SEC/T/250		2		1	
	ENS/SEC/P/ 277	**SEC03292574P**	Practicals based on ENS/SEC/T/251		2		1	
AEC, VEC, IKS	**SUB/AEC/T/250**		Modern Indian Language (MIL-2) (Choose any one from pool of language courses)	2		2		02
OJT/ FP/CEP/CC/RP	SUB/FP/P/ 276		Field Project		4		2	2+2= 04
	SUB/CC/P/ 277		(Fine/ Applied/ Visual/ Performing Arts) (Common for all the faculty)		4		2	
				13	**18**	**13**	**09**	**22**
Exit Option: Award of UG Diploma in major and minor with 88 credits and an additional 4 credits NSQF course (related to major / minor) / Internship during summer vacation OR Continue with Major and Minor								

Minor Courses for other Discipline

ENS/Mn/T/ 250: This is a 2-credit theory course to be designed for other discipline

ENS/Mn/T/ 251: This is a 2 credit theory course to be designed for other discipline

Generic /Open Elective Courses for other faculty

ENS/GE/OE/T/250 : This is a 2 credit theory course to be designed for other faculty

B.Sc. Second Year: Semester –III
Subject: Environmental Science
Major Course: ENS/DSC/T/200
Environmental Plan, Policies & Legislation

ENS/DSC/T/200: Environmental Plan, Policies & Legislation

Total Credits: 02 **Total Contact Hours: 30 Hrs.**
Maximum Marks: 50

Learning Objectives of the Course: Students will be able to know

i) Importance of Environmental Legislation & Policy
ii) Prevention Strategies & pollution Control
iii) International & National Policies for protection & Development of Environment
iv) Need & Law, Importance of Environmental Legislation.
v) Prevention & Control Rules & Regulations.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No. of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Course Outcomes (COs):

After completion of the course, students will be able to –

i) Students will learn about Environmental rules and laws
ii) Student will get the knowledge about Policy & Protection
iii) Study the legal provisions made by various Environmental concern acts
iv) Explain need of laws, importance of environmental legislations, governmental policies for protection and development of environment.

oduleNo.	**Topics / actual contents of the syllabus**	**Contact Hours**
I	**Unit - I: Introduction** Concept, Need of laws, Importance of Environmental Legislation, National Environmental Policy Act (NEPA), History of Environmental laws in India: Laws about Environment in Historic Period, Environment related laws during British Rule, Constitutional Provision to Environment: Legal definitions (Environmental pollution, natural resource, biodiversity, forest, sustainable development)	**10 Hrs**
II	**Unit - II: Legislative Instruments in India** The Indian Forest Act 1927; The Wildlife (Protection) Act 1972; The Water (Prevention and Control of Pollution) Act 1974; The Forests (Conservation) Act 1980; The Air (Prevention and Control of Pollution) Act 1981; The Environment (Protection) Act 1986.	**10 Hrs**
III	**Unit III: Environmental Policy**: Government Policies in the protection & development of Environment, Role of Ministry of Environment, Forests & Climate Change in environmental law and policy making; role of central and state pollution control boards in environmental law and policy making. Stockholm Conference 1972; United Nations Conference on Environment and Development 1992; Rio de Janeiro (Rio Declaration, Agenda 21.	**10 Hrs**

Text Books:

1. Hand Book of Env. Laws, Acts, Rules, Guidelines, Compliance and Standard Vol. 1 & 2: R.
2. K. Trivedi Environmental Edition: 1st 1996.
3. Pollution control Acts, Rules and notifications issued there under: Central Pollution Control
4. Board April. 1995.
5. Environmental Protection and the Laws: C. N. Mehta, 1991.
6. Environmental Policy: New Directions for the Twenty-First Century" by Norman J. Vig and
7. Michael E. Kraft
8. "Environmental Law and Policy" by Jonathan R. Nash
9. "The Principles of Sustainability" by Simon Dresner
10. Introduction to Environmental Impact Assessment" by John Glasson, Riki Therivel, and Andrew Chadwick
11. "Governing the Environment: Interdisciplinary Perspectives" edited by Marc Allen Eisner, Kristin R. Schreckhise, and Kevin T. Smith

Reference Books:

1. Hand Book of Env. Laws, Acts, Rules, Guidelines, Compliance and Standard Vol. 1 & 2: R. K. Trivedi Environmental Edition: 1st 1996.
2. Pollution control Acts, Rules and notifications issued there under: Central Pollution Control Board April. 1995.
3. Environmental Protection and the Laws: C. N. Mehta, 1991.
4. Legal aspects of Environmental Pollution and its Management: Ed. S. M. Ali, 1992.
5. International Environmental Policy Emergence and Dimensions: by L. K. Caldwel 1990.
6. Lal'sCommentevis on water, Air pollution laws along with the environmental (Protection) Act and rules 1986, 3rd Rd. 1992: Law Publisher India.
7. Universal Environment and Pollution law manual: S. K. Mohanty 1998.
8. Pares Distn. Environmental Laws in India: (Deep, LatedEdn).
9. Environmental Problems, protection and control Vol I &Vol II Ed: Arun Kumar.

B.Sc. Second Year, Semester III[rd]
Subject: Environmental Science
Major course: ENS/DSC/T/201
Environmental Instrument and Analysis

Course Objectives
Students will be able to know

1. To provide a comprehensive understanding of the principles and applications of environmental instruments.
2. To train students in sampling techniques and laboratory analysis of environmental parameters (air, water, soil).
3. To develop the ability to interpret analytical data for environmental monitoring and compliance.
4. To introduce modern instrumentation such as spectrophotometry, chromatography, and sensor-based systems.
5. To promote practical skills in handling and calibrating environmental equipment.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit-I: - Sampling and Sample Preparation: 10 hrs

Air, Water, Soil and sediment; Types of Samples-Grab samples, composite samples, Integrated samples, Sampling methods- Manual sampling, Automatic sampling, Sorbent sampling; Sampling types- Simple random sampling, Systematic random sampling, Stratified random sampling, Representative sampling, Geo-statistical (random field) sampling, Adaptive cluster sampling; Sample collection equipments.

Unit — II :- Analytical Techniques: 10 hrs

Theory, principles, instrumentation and Environmental application- pH, conductivity, Turbidity, Titriometry, Colorimetry, Spectrophotometry, Atomic Absorption Spectroscopy (AAS, Flame emission spectrometry).

Unit-III :- Separation Techniques: 10 hrs

Principles, Types and Environmental application- Sedimentation, Centrifugation, Electrophoresis, Chromatography-paper. Theory, principles, working and application of Colony Counter, microscope, Autoclave, Oven, Incubator, Laminar air flow and BOD incubator.

Course Outcomes

After Completion of the Course, Students will be able to:

1. Comprehend the various sampling technique and its application.
2. Select sampling methods for making unbiased research.
3. Categorize analytical instruments used for environmental problems.
4. Students are expected to have a basic knowledge on various separation techniques such as chromatography and analytical methods like titriometry.

Textbooks and References:

1. Practical Biochemistry by Willson & John Walker
2. Instrumental Methods of Chemical Analysis by Sharma, B.K.
3. Instrumental methods of analysis by Malathi, S., Patil, P. M., Kumar, S
4. Standard Methodology of Biochemical Analysis by SK Thimmayiah,
5. Environmental Instrumentation and Analysis Handbook by Randy D. Down and Jay H. Lehr
6. Environmental Analysis and Instrumentation by N. Rajvaidya and D. K. Markandey
7. Instrumentation and Measurement for Environmental Sciences by Bailey W. Mitchell.
8. Environmental sampling and analysis: a practical guide. Routledge by Keith, L. H.
9.https://cpcb.nic.in/displaypdf.php?id=c291cmNlYXBwb3J0aW9ubWVudHN0dWRpZXMucGRm
10. https://cpcb.nic.in/manual-monitoring

B.Sc. Second Year: Semester –III

ENS/DSC/P/ 226 (Practical based on ENS/DSC/T/200)

(02- Credit)

(Lab Course with 02 credit, 60 Contact Hours, Marks -50)

1. Conduct an EIA for a proposed local development project.

2. Analyze a specific environmental policy (e.g., Clean Air Act, Paris Agreement) and evaluate its effectiveness.

3. Conduct a case study on a city has implemented sustainable urban planning practices.

4. Perform water quality tests on a local water body.

5. Conduct a biodiversity assessment in a local natural area.

6. Calculate the carbon footprint of a local community or institution.

7. Design a small-scale renewable energy project (e.g., Solar panel installation).

8. Develop a waste management plan for a local community or institution.

9. Organize and conduct a workshop to engage the public in environmental decision-making.

10. Compare environmental laws from different countries or regions.

11. Use Geographic Information Systems (GIS) to create maps for environmental planning purposes.

12. Conduct air quality measurements in different areas and analyse the data.

13. Evaluate the sustainability of agricultural practices on a local farm.

14. Evaluate the sustainability of agricultural practices on a local farm.

15. Conduct a compliance audit of a local business or industry with respect to environmental regulations.

B.Sc. Second Year, Semester IIIrd

ENS/DSC/P/ 227 (Practical based on ENS/DSC/T/201)

(02- Credit)

(Lab Course with 02 credit, 60 Contact Hours, Marks -50)

1. Study on the principle, component and working operation of Flame photometer and its applications.
2. Measurement of turbidity of turbid water samples by using a Turbidimeter.
3. Measurement of conductivity of water samples by using Conductometer.
4. Estimation of phosphate content from sewage samples by using a Spectrophotometer.
5. Estimation of ammonia content from sewage samples by Colorimeter.
6. Determination of pH of given water/soil samples by using a pH meter.
7. Estimation of heavy metals (Copper and Mercury) from water samples by using an Atomic absorption spectrophotometer.
8. Estimation of sodium content form water sample by using Flame photometer.
9. Estimation of potassium form water sample by using Flame photometer.
10. Determination of fluorescent compound by using a Photoflorometer.
11. Separation of a mixture of amino acids by using Paper chromatography.
12. Determination of Dissolved oxygen content from water samples by using a DO meter.

B.Sc. Second Year: Semester –III
Subject: Environmental Science
Minor Course: ENS/Mn/T/ 200
Application of Environmental Biotechnology in Agriculture

Course objectives

Students will be able to know

1. This course is designed to impart knowledge and skill on understanding the Concepts of diversified Biotechnological application in the field of Agriculture.
2. This will develop an understanding and comprehensive overview of how environmental biotechnology is being applied to address challenges and promote sustainability in agriculture.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No. of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit –I Introduction **to Environmental Biotechnology:** **10 hrs**

Definition, scope, and importance in the context of agriculture.

Microbial Ecology: Understanding the role of microorganisms in soil health, nutrient cycling, and bioremediation.

Unit-II Applications in Agriculture: **10 hrs**

Bioremediation of contaminated sites using Microorganism, Phytoremidiation using plants in soil and water. Biofertilizers Production and its application to enhance soil quality and crop yield (e.g., nitrogen-fixing bacteria, phosphate-solubilizing bacteria) Biopesticides, Biological controlling agents their use to control pest and diseases on the crops.

Unit-III Waste Management: **10 hrs**

Waste management, Composting, Composting, anaerobic digestion, and other biotechnological approaches for managing agricultural waste (e.g., crop residues, animal manure). Composting, anaerobic digestion, and other biotechnological approaches for managing agricultural waste (e.g., crop residues, animal manure).

Course Outcome:

After Completion of the Course, Students will be able to:

1. learn and gain knowledge about Concept of application of diversified biotechnological applications in the field of Agriculture
2. Gain the knowledge about Concept, types, components, production and application and impacts of Biofertilizers, Biopesticides,
3. Learn to apply technical knowledge and skills required for understanding and application of the Agriculture Biotechnology
4. Evaluate the situation and present status prevailing in the field and act accordingly

Books Recommended:

1. Casida LE. (1991). Industrial Microbiology. 1st edition. Wiley Eastern Limited.
2. Crueger W and Crueger A. (2000). Biotechnology: A textbook of Industrial Microbiology. 2nd edition. Panima Publishing Co. New Delhi.
3. Patel AH. (1996). Industrial Microbiology. 1st edition, Macmillan India Limited.
4. Stanbury PF, Whitaker A and Hall SJ. (2006). Principles of Fermentation Technology. 2nd edition, Elsevier Science Ltd.
5. Ashim Kr Chakravarty , Introduction to Biotechnology , OUP
6. S.N. Jogdand , Advances In Biotechnology , Himalaya
7. A . K . Chatterjee , Environmental Biotechnology , PHI
8. H.D.Kumar , Modern Concepts of Biotechnology , Vikash Publication
9. T Srinivas , Environmental Biotechnology , New Age International
10.R.K.Sharma Agriculture at a Glance , Astral Publication

B.Sc. Second Year; Semester – III
Subject: Environmental Science
ENS/Mn/T/ 201
Classification & Quantification of Major Air, Water & Soil Pollutants.

(Minor Theory Course with 02 credit, 30 Contact Hours)

Course Objectives:

1. To provide fundamental knowledge about the nature and types of environmental pollutants in air, water, and soil.
2. To classify major pollutants based on their physical, chemical, and biological characteristics.
3. To introduce students to the sources and impacts of pollutants on health, ecosystems, and climate.
4. To equip students with standard methods of sampling and quantifying environmental pollutants.
5. To enhance analytical skills through understanding modern tools and techniques used in pollution analysis and monitoring.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit I: Classification and Characteristics of Air Pollutants 10 hrs.

- Introduction to air pollution: primary and secondary pollutants
- Classification of air pollutants: based on origin, state (gaseous/particulate), chemical composition
- Major air pollutants: SO_2, NO_x, CO, CO_2, hydrocarbons, ozone, particulate matter (PM2.5, PM10)
- Sources of air pollutants: natural and anthropogenic
- Effects on health, vegetation, visibility, and materials
- Global issues: smog, acid rain, ozone depletion, greenhouse effect

Quantification Techniques:

- Gravimetric and volumetric methods for particulates
- Gas chromatography, UV spectrophotometry for gaseous pollutants
- Air Quality Index (AQI) and monitoring standards (CPCB, WHO)

Unit II: Classification and Analysis of Water Pollutants **10 hrs.**

- Classification of water pollutants: physical, chemical, biological
- Major pollutants: heavy metals (Hg, Pb, Cd), nutrients (nitrates, phosphates), pathogens, pesticides, detergents, oil and grease
- Sources: domestic sewage, industrial effluents, agricultural runoff
- Eutrophication, biomagnification, BOD and COD concept
- Health and ecological impacts

Quantification Techniques:

- Determination of BOD, COD, DO, pH, TDS, turbidity
- Spectrophotometric analysis for nitrates and phosphates
- Atomic Absorption Spectrophotometry (AAS) for heavy metals
- Microbial analysis: coliform test

Unit III: Classification and Detection of Soil Pollutants **10 hrs.**

- Soil pollution: definition and types
- Classification of pollutants: inorganic (metals, salts), organic (pesticides, hydrocarbons), biological (pathogens)
- Major sources: fertilizers, pesticides, industrial sludge, mining
- Impacts on soil fertility, microbial activity, and food chain contamination
- Soil salinization and acidification

Quantification Techniques:

- Soil sampling techniques
- Determination of pH, organic carbon, and nutrient status
- Analysis of heavy metals and pesticides using AAS, GC-MS
- Bioassays for toxicity assessment

Course Outcome (Cos):

By the end of this course, students will be able to:

1. Identify and classify major pollutants in air, water, and soil based on their origin, form, and effects.
2. Describe the sources and environmental impacts of major air, water, and soil pollutants
3. Apply standard environmental monitoring techniques to quantify selected pollutants.
4. Interpret pollution data using appropriate indices (e.g., AQI, BOD, COD) and relate them to national and international standards.
5. Demonstrate basic skills in pollutant sampling, laboratory analysis, and interpretation of results for environmental quality assessment.

Book References:

1. **C.S. Rao**, *Environmental Pollution Control Engineering*, New Age International Publishers
2. **M.N. Rao & H.V.N. Rao**, *Air Pollution*, Tata McGraw-Hill
3. **S.P. Mahajan**, *Air Pollution Control*, TERI Press
4. **P.K. Goel**, *Water Pollution: Causes, Effects and Control*, New Age International
5. **K.N. Duggal**, *Elements of Environmental Engineering*, S. Chand
6. **Sawyer, McCarty & Parkin**, *Chemistry for Environmental Engineering and Science*, McGraw-Hill
7. **A.K. De**, *Environmental Chemistry*, New Age International
8. **Dara S.S.**, *A Textbook of Environmental Chemistry and Pollution Control*, S. Chand
9. **R.K. Trivedy & P.K. Goel**, *Chemical and Biological Methods for Water Pollution Studies*, Environmental Publications
10. **I. B Ghorude, S.N. Bansal & Dharmendra,** Environmental Science, Scientific International publication house. Tamilnadu.

B.Sc. Second Year: Semester –III
Subject: Environmental Science
Generic Elective (GE)/Open Elective (OE)
for other faculty students
ENS/GE/OE/T/200
Environmental Meteorology & Geological Hazards

Course objectives

Students will be able to know

1. This course is designed to impart knowledge and skill on understanding the Concepts of Meteorology and geological hazards.
2. To acquire the basic knowledge of climate and weather and its impact on Environment.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No. of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test/Tutorials/seminar	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
Total Credits	:-	02	**Total Marks**	:-	50

Unit –I Introduction **to Environmental Meteorology: 10hrs**

Meteorology: Definition. Primary meteorological parameters and their measurement: temperature, wind direction and speed. Secondary meteorological parameters and their measurement: humidity, precipitation, pressure and solar radiation. Weather forecasting: methods, types, role of satellite in weather forecasting

Unit-II Atmosphere and Climatology 10 hr

Atmosphere**:** Segments of total environment. Structure of atmosphere on the basis of Composition, Temperature, Pressure. Chemical species and particulates in the atmosphere. Climatology: Definition, scope Difference between weather and climate. Condensation. Forms of condensation. Precipitation. Forms of precipitation. Fog: a simplified classification. Clouds and its classification.

Unit-III Geological Hazards 10 hrs

Definition of Geological Hazards, Types of geological hazards **(**earthquakes, volcanoes, landslides, floods, and other natural disasters, including their causes, impacts, and mitigation strategies) Geological hazards in Indian context.

Course Outcome:

After Completion of the Course, Students will be able to:

1. Students will retain knowledge relevant to Meteorology
2. Gain the information of weather and climate which are considered as basic input in Environmental planning and agricultural planning
3. Explain Weather hazards, and other geological hazards and will get knowledge of preparedness
4. Acquaint with the meteorological instruments and knowledge about different meteorological parameters.

Books Recommended:

1. Fundamentals of Agrometeorology Mahi, G.S. and Kingra, P.K. 2015 Publisher: Kalyani Publishers, New Delhi.
2. Agrometeorology Reddy, S. R. and Reddy, D.S. 2014 Publisher: Kalyani Publishers New Delhi.
3. Comprehensive Agrometeorology Mahi, G.S. and Kingra, P.K.
4. Introduction to Agriculture and Agrometeorology Reddy, S. R. 2014 Publisher: Kalyani Publishers New Delhi.
5. A textbook of environment –Agrawal, Mcmillion publication, Mumbai
6. A textbook of geology –Purbeen Singh. 4. Climatology – D.S. Lal, Sharda Pustak Bhawan, Allahbad, 2003.
7. Environmental Chemistry – S.S. Dara, S. Chand and Company, New Delhi 2002.
8. Environmental Chemistry- B.K. Sharma, Goel Publication, Meerut. 7. Air Pollution – M.N. Rao, Tata McGraw Hill Publishing Company Limited, New Delhi, 2003
9. Air Pollution –A .C. Stern 9. Environmental Problems and solution- Asthana, S. Chand and company, New Delhi.
10. Environmental Science-S.C. Santra, New Central Book Agency private LimitedMan and Environment-P.R. Trivedi, Gurdeep Raj, Akshadeep Publishing House, New Delhi, 1997.
11. Environmental Studies-Kuashik and Kaushik, New Age International Publishers, 2004.
12. Environmental Geography-Savindra Singh. Prayag Pustak Bhawan, Allahabad (U.P.) 2001.

B.Sc. Second Year: Semester –III
Subject: Environmental Science
Generic Elective (GE)/Open Elective (OE)
for other faculty students
ENS/GE/OE/T/201
Environmental Sustainability Issues in Industries

Course Objectives:

1. To understand the environmental impacts caused by various industrial activities.
2. To identify sustainable practices that can be adopted within industrial operations.
3. To develop knowledge of environmental laws and compliance mechanisms for industries.
4. To introduce modern concepts like cleaner production, environmental audits, and green certifications.
5. To enable students to critically evaluate and recommend sustainable solutions in industrial sectors.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No. of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal External exam)	:-	40%
	:-	02	Total	:-	50

Unit I: Industrialization and Environmental Impact 10 hrs.

- Introduction to industrial development and environment
- Industrialization: historical context, present scenario in India
- Types of industries and their environmental footprints
- Key environmental issues: air, water, soil, and noise pollution
- Case studies of major polluting industries (textile, chemical, tannery, paper, thermal power plants

Unit II: Resource Use and Sustainable Industrial Practices 10 hrs.

- Industrial resource consumption: energy, water, raw materials
- Concepts of sustainability in industry: 3Rs (Reduce, Reuse, Recycle)

- Cleaner Production (CP), Waste Minimization Techniques
- Environmental Management Systems (EMS) and ISO 14001
- Energy-efficient technologies and sustainable product design

Unit III: Environmental Regulations, Audits, and Industrial Responsibility 10 hrs.

- Environmental regulations relevant to industries: Water Act 1974, Air Act 1981, EPA 1986
- Consent mechanisms by Pollution Control Boards
- Industrial compliance and enforcement mechanisms
- Environmental Impact Assessment (EIA) for industries
- Environmental Audit: process, types, benefits
- Corporate Environmental Responsibility and Sustainable Development Goals (SDGs) in industry

Course Outcome (Cos):

By the end of this course, students will be able to:

1. Describe the types of industries and their specific environmental challenges
2. Analyze resource consumption patterns and propose sustainable alternatives in industrial processes.
3. Apply the concepts of cleaner production, waste minimization, and the 3R approach to real-life case studies.
4. Explain the legal framework and regulatory requirements for industrial environmental compliance in India.
5. Understand and evaluate environmental audits and Environmental Management Systems (EMS) in industries.
6. Assess the role of industries in achieving Sustainable Development Goals (SDGs) and environmental responsibility.

Book References:

1. **C.S. Rao**, *Environmental Pollution Control Engineering*, New Age International
2. **A.K. De**, *Environmental Chemistry*, New Age International
3. **S.M. Khopkar**, *Environmental Pollution Analysis*, New Age International
4. **P.N. Muttagi**, *Environmental Management*, Deep & Deep Publications
5. **Benny Joseph**, *Environmental Studies*, McGraw Hill Education
6. **N.K. Uberoi**, *Environmental Management*, Excel Books
7. **R.K. Trivedy**, *Environmental Management*, Akashdeep Publishing
8. **Agarwal & Kaushik**, *Environmental Management*, New Age International
9. **R. Rajagopalan**, *Environmental Studies: From Crisis to Cure*, Oxford University Press

B.Sc. Second Year, Semester III[rd]
Subject: Environmental Science
ENS/VSC/T/200
Socioeconomic Aspects of Environment

Course Objectives

Students will be able to know

1. To examine the relationship between environmental systems and socio-economic structures.
2. To assess the effects of population growth, poverty, and urbanization on natural resources.
3. To explore the concepts of environmental justice, equity, and sustainable development.
4. To understand the role of communities, gender, and indigenous groups in environmental protection.
5. To promote awareness of how socio-economic policies impact the environment and vice versa.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	1 hr/week	Continuous Internal Assessment by teacher	:-	10
Total No. of Lectures /Hours/ Semister	:-	15hr/Semister	Sem-End Examination	:-	15
Test	:-	2hr/semester	Marks for Passing (Internal External exam)	:-	40%
Total Credits	**:-**	**01**	**Total Marks**	**:-**	**25**

Unit I: Global and National Environmental Movements 08 hrs

Global and national environmental movements - Global environmental movements and initiatives - Green Peace, IUCN, WWF, World Watch Institute, Wetland International, etc. Environmental movements: - Chipko, Narmada Bachao Andolan, Save Western Ghats.

Women and Environment, Human Interference, Wildlife Conflict, Social problems due to rehabilitation and resettlement due to developmental projects.

Unit II: Sustainable Development 07 hrs

Concept, Definition of sustainable development integrating economic and ecological principles. Concept of eco-development, Integrating economic and ecological principles, Western Ghats eco-development plan, developmental models for the hilly area, river basins.

Course Outcomes

After Completion of the Course, Students will be able to:

1. Helps assess how human activities contribute to environmental degradation and what solutions are socially viable.
2. Promotes balanced approaches to growth that consider ecological limits, social well-being, and economic needs.
3. Encourages public participation, awareness, and education in environmental decision-making processes.

Reference:

1. Environmental Economics in theory and practice – Hanley, Shogren and White.
2. Cost benefit analysis and the environment – Hanley, Splash.
3. Environmental Economics- Karpagam.
4. Environmental Economics- G.N. Singh.
5. Environmental Economics- R.N. Bhattachary

B.Sc. Second Year: Semester –III
Subject: Environmental Science
ENS/VSC/T/201
Man & Wildlife Conflict

Man & Wildlife Conflict

Total Credits: 02 **Total Contact Hours: 30 Hrs**
Maximum Marks: 50

Learning Objectives of the Course:

Students will be able to

vi) To understand the value of wildlife, its ecological importance and its scientific, commercial and ethical value.

vii) Explain the threats and causes of loss of wild life and extinctions of wild species from India.

viii) Illustrate different wild life conservation methods, and importance of protected area conservations such as national parks, biosphere reserves, zoos, botanical garden and gene banks.

ix) Know the importance of man and wildlife conflict, management of wild life, forest fires protection.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test/Tutorials/seminar	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
Total Credits	:-	02	**Total Marks**	:-	50

Course Outcomes (COs):

Students should be able to:

1. Identify the value of wildlife, its ecological importance and its scientific, commercial and ethical values.
2. Examine the threats and causes of loss of wildlife, extension of wildlife species from India.
3. Assess different wildlife conservation methods and importance of protected area such as national parks, biosphere reservoirs, zoo, botanical gardens and gene bank.
4. Evaluate importance of man and wildlife conflict, management of forest fires, shelters and corridors management for wildlife protection.

oduleNo.	**Topics / actual contents of the syllabus**	**Contact Hours**
I	**Unit-I: - Introduction to wildlife: 10** Definition and concept of wildlife, Value of wildlife- ecological importance, Commercial value, Scientific value, Game value, Recreational value, and Ethical value, Status of wildlife-abundant, Threatened, Endangered, Greatly endangered, Extinction-prone, Extinct, and vermin, Wildlife distribution in India-Himalayan mountain system (north east and north west), Peninsular India, Tropical rainforest region of Indian, Indian desert.	**10 Hrs**
II	**Unit- II: - Threats and causes of loss of wildlife:**	**10 Hrs**

	Pollution, Hunting, Superstitions, over exploitation, Developmental activities, Mining, Destruction of forest, Habitat degradation, Trade in wildlife-history of trade in wildlife, Trade in live animals, Trade in wildlife products, Wildlife trade in India, CITES.	
III	**Unit- V- Wildlife Management:** Man and Wildlife Conflicts-Concept, Need of wild life management, Wildlife management principles, Wildlife management techniques, Control hunting technique, Ecosystem management for wildlife, Sanctuary and national park management, Management of forest fires, Management of water resources, Shelters, Habitats, roads, Corridors management for wildlife.	**10**

Reference Books:

1. Principles of Environmental Science - Cunningham and Cunningham
2. Ecology, Environment and Resource Conservation (2006): Singh JS, Singh SP and Gupta SR; Anamaya Publ, New Delhi.
3. Fundamental of Ecology (1971): EP Odum; WB Saunders Company.
4. Plant Diversity Hotspots in India (1997): PK Hajra and V. Mudgal; Botanical Survey of India
5. Environmental Management (2005): Bala Krishnamoorthy; Prentice-Hall of India Pvt. Ltd.,New Delhi.
6. Zoos in India: legislation, policy, Guidelines and strategy, Central zoo authority, New Delhi 2007.
7. Wildlife ecology, conservation and Management, Anthony R.E.Sinclair, John M.Fryxell and Graeme Caughly , Blackwell publishing,U.S,A. 2006.
8. Colorful Atlas on Indian wildlife Siseases and Disorders, Arora dnBipulchakraborthy B.M.IBDC, Lucknow,2008.
9. Indian wildlife yearbook ,Arora B.M., Editor., AIZ and WV .Bareilly and central zoon authority, New Delhi 2002.
10. Rehabilitation in free living wild animals, Arora.B.M. AIZ and W,V.,Bareilly., 2007.
11. Reproduction in Wild Mammalia & Conservation, Arora B.M. AIZ and WV., 2002.
12. Wild Animals in Central India, Brander,A.A. Natraj Publisher, Dehradun.
13. The Temple Tiger. Corbett,Jim., Oxford University Press, New Delhi., 2007.
14. Handbook of Environment, Forest and Wildlife Protection Laws in India., justice Kuldip Singh, Natraj Publishers, Dehradun., 1998.
15. Biodiversity conservation in managed and protected areas, katwalf Banerjee, Agrobios, India., 2002.
16. The Ecology of wildlife Diseases. Peter J.Hudson, Annapaola Rizzoli, Bryan T. Grenfell, Hans Heestribeek and Andy P. Dobson, Oxford University Press. Oxford ., 2002.
17. Text book of wildlife management, Singh, S.K, IBDC, Lucknow., 2005.

B.Sc. Second Year: Semester –III
Subject: Environmental Science
ENS/VSC/P/226
(Practical Based on ENS/VSC/T/200)
(01 Credit)

Socioeconomic Aspects of Environment

(Lab Course with 01 credit, 30 Contact Hours, Marks -50) (CIA-20, SEE-30)

List of Practicals:

1. Preparation of questionnaire/schedule for environmental and social data collection.
2. Conducting field surveys in rural or urban areas to assess environmental awareness, resource use, income levels, etc.
3. Survey to assess impact of urban growth on air, water, waste, and green spaces.
4. Field visit to an urban area for solid waste generation and disposal pattern analysis.
5. Designing and conducting environmental awareness campaigns (poster-making, street plays, group discussions).
6. Review and presentation of key socio-environmental government schemes like MGNREGA, Jal Shakti Abhiyan, Swachh Bharat, etc.
7. Case study on Self Help Groups (SHGs) or local NGOs involved in natural resource conservation.
8. Visit to a Joint Forest Management (JFM) village or watershed project site.
9. Visit to an industrial zone and assess its impact on local population (livelihood, health, displacement).
10. Interaction with local stakeholders to understand conflict, compensation, and corporate social responsibility (CSR).

B.Sc. Second Year: Semester –III
Subject: Environmental Science
ENS/VSC/P/227
(Practical Based on ENS/VSC/T/201)
(01 Credit)

(Lab Course with 01 credit, 30 Contact Hours, Marks -50) (CIA-20, SEE-30)

1. Identification of wild animals by using pug marks.
2. Identification of wild species by using feeding signs and artifacts.
3. Determination of relative abundance of light attracting insects by using light trap.
4. Determination of bird's population by using Lincoln index (Simulation)
5. Identification of mammals from the hair morphology and histology.
6. To study the bird species by using vocal display.
7. Identification of wild species by direct observation in their habitat.
8. Determination of burrowing animal's population by using their artifacts.
9. Field visit for the study of wild species and collection of samples from various domestic and wild animals.
10. Visit to Zoo/ National Park /Sanctuary / Aquarium etc. for the study of wildlife.
11. Field visit to study the habitat components of wild species.
12. To study the natality of wild species during breeding season at zoo/aquarium / in closed ecosystem.

B.Sc. Second Year: Semester –IV
Subject: Environmental Science
Major course: ENS/DSC/T/250
Biogeographic & Physiogegraphic Zones of India

Course objectives

Students will be able to know

1. This course is designed to impart knowledge and skill on understanding the Concepts of diversified Biogeographic zones.
2. This will develop an understanding and comprehensive overview of how much important this Biogeographic zone are and being applied to address challenges and promote sustainable development.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No. of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit –I Introduction to Biogeographic Zones of India: 10 hrs

Definition of **Biogeographic Zones and its** importance. Background of Biogeographic zones of India, Different kinds of Biogeographic zones in India, Factors behind the diverse range of Biogeographic zones in India (Topography, Monsoon, Coastal Influence, Soil diversity. Etc.)

Unit-II Factors Affecting and challenges faced by Biogeographic Zones : 10 hrs

Factors Affecting(climate, Environmental factors, Geography & Topography)

Challenges faced by Biogeographic Zones of India(Habitat loss and fragmentation, Deforestation, climate change, Human wild-life conflicts, Invasive species)

Unit-III Physiography of India 10 hrs

Definition, Physiographic divisions of India : the Himalayas, the Northern Plains, the Peninsular Plateau, the Indian Desert, the Coastal Plains, and the Islands. Major Rivers in Physiographic divisions of India.

Course Outcome:

After Completion of the Course, Students will be able to:

1. learn and gain knowledge about Concept of Biogeographic zones of India
2. Gain the knowledge about Concept , types , components , production and application and impacts of Biofertilizers, Biopeticides ,
3. Learn to apply technical knowledge and skills required for understanding and application of the Agriculture Biotechnology
4. Evaluate the situation and present status prevailing in the field and act accordingly

Books Recommended:

1. Cox, C. (2006) A history of biogeography, Biogeography an ecological and evolutionary approach, Blackwell publishing.
2. Majid Husain ,Geography of India IInd Edition 2011
3. K.Manikandan Indian Forestry 2010
4. Biogeography by Savindra Sing 2011
5. S.P.Misra , S.N Pandy Essential Environmental Studies 2020
6. Humphries,C.J and Parenti,L.R. (1999) Cladistic biogeography, Interpreting patterns of plant and animals distributions, 2nd ed., Oxford University press, Oxford.
7. Myers, N., Mittermeler, R.A., Mittermeler C.G, Foneseca, G.A.B.D, Kent,J. (2000) Biodiversity hotspots for conservation priorities. Nature.Vol. 403 No.10
8. MoEF & Kalpavriksh.2004.Nat.Biodiversity Strategy and Action Plan,India:Final Tech.Report of the UNDP/GEF Sponsored Project.MoEF,Govt.of India,& Kalpavriksh,New Delhi/Pune
9. Rodgers, W.A. and Panwar, H.S. (1988) Planning a wildlife protected area network in India. 2 vols. Project FO: IND/82/003. FAO, Dehra Dun. 339, 267 pp.
10. Sharma, P.D. (2009) Biodiversity and wildlife of India and its conservation, Ecology and Environment, Rastogi publications
11. Singh, J.S. (2006) Biogeography and life zones, Ecology Environment and resource conservation, Anamaya publishers.

B.Sc. Second Year, Semester IVth
Subject: Environmental Science
Major Course: ENS/DSC/T/251
Ground Water Engineering and Watershed Management

Course Objectives

Students will be able to know

1. To understand the occurrence, movement, and recharge of groundwater resources.
2. To study various groundwater exploration, development, and artificial recharge methods.
3. To introduce watershed concepts and integrated watershed management strategies.
4. To evaluate the impact of land use and human activity on watershed hydrology.
5. To develop sustainable solutions for water conservation, soil erosion control, and drought management.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit I: Introduction to Groundwater **10 hrs**

Importance and Role in sustainable water resource management,
Occurrence of Groundwater- Hydrologic cycle overview (specific to groundwater), Zones of aeration and saturation.

Unit II: Well and Groundwater Exploration **10 hrs**

Types of Wells- Open wells, tube wells, infiltration galleries, Dug wells, bored wells, and driven wells, Suitability and construction techniques. Methods of Artificial Recharge-Surface spreading techniques: percolation tanks recharge basins, check dams, Subsurface recharge techniques: recharge wells, injection wells, shaft recharge

Unit III: Watershed Management **10 hrs**

Introduction to Watershed - Definition and concept of a watershed, Importance in water resource planning and rural development.
Soil Erosion and Its Impact- Types of erosion: sheet, rill, gully, Factors affecting erosion
Importance of Watersheds, Objectives of Watershed Management, Strategies of Watershed Management. Integrated Watershed Development Programme(IWDP).
Community-Based Watershed Management.

Course Outcome:

After Completion of the Course, Students will be able to:

1. Ensures equitable distribution and sustainable use of groundwater resources
2. Promotes recharge and prevents overexploitation of aquifers
3. Reduces soil erosion and land degradation
4. Improves agricultural yield and livelihoods in rural areas
5. Supports climate resilience and drought-proofing strategies

Textbooks and References:

1. Raghunath, H.M., "Groundwater Hydrology", New Age International.
2. Todd, D.K. & Mays, L.W., "Groundwater Hydrology", Wiley.
3. Murthy, J.V.S., "Watershed Management", New Age International.
4. Michael, A.M., "Irrigation Theory and Practice", Vikas Publishing.
5. BIS Codes and Guidelines on Watershed and Groundwater.
6. Sharma, B.K.**,** "*Environmental Chemistry*", Goel Publishing House, Meerut.
7. Ecology and Environment – P.D. Sharma, Rastogi Publication, Meerut.
8. Principles of Ecology – P.S. Verma and V.K. Agarwal
9. A.K. De- Environmental Chemistry
10. Soil and Water Conservation–Resurges, Standard pub. And distributor.

B.Sc. Second Year: Semester –IV
Subject: Environmental Science
ENS/DSC/P/276
(Practical Based on ENS/DSC/T/250)
(02 credit)

List of Practicals:

1. Field Study: Investigate the unique flora and fauna adapted to high-altitude cold desert / Hot Desert / River conditions.
2. Vegetation Survey: Identify and analyse the sparse vegetation cover, including lichens, mosses, and hardy shrubs
3. Vegetation Survey: Examine different forest types (subtropical, temperate, alpine) and their characteristic tree species (e.g., oak, pine, deodar).
4. Study of Soil Profile to nearby area of (college campus/ village).
5. Study of different types of soil in Maharashtra.
6. Determination of pH / conductivity from provided sample soil
7. Study of water holding capacity of different soil sample
8. Study soil sampling techniques
9. Demarcation of Biogeographic zones on the given map
10. Demarcation of different major rivers on the given map
11. Study of different watershed methods for water conservation.
12. Study of different endemic, endangered and invasive species
13. Rainfall measurement by rain gauge meter
14. Mapping of soil type (Near by defined area)

B.Sc. Second Year: Semester –IV
Subject: Environmental Science
ENS/DSC/P/277
(Practical Based on ENS/DSC/T/251)
(02 credit)

1. Determination of Dissolve Oxygen of Ground Water Sample
2. Determination of Biological Oxygen Demand
3. Determination of Chemical Oxygen Demand
4. Preparation of hydrogeological maps.
5. Conducting well inventory surveys (open wells and borewells).
6. Determination of – pH from Ground Water Sampling
7. Determination of - TDS from Ground Water Sampling
8. Determination of – Hardness from Ground Water Sampling
9. Determination of – Chloride from Ground Water Sampling
10. Determination of – Nitrate from Ground Water Sampling
11. Determination of – Fluoride from Ground Water Sampling
12. Determination of – Phosphate from Ground Water Sampling
13. Determination of – Arsenic from Ground Water Sampling

B.Sc. Second Year: Semester –IV
Subject: Environmental Science
Minor Course: ENS/Mn/T/250
Energy Resource Management & Green Initiatives

Energy Resource Management & Green Initiatives

Total Credits: 02 **Total Contact Hours: 30 Hrs**
Maximum Marks: 50

Learning Objectives of the Course:

Students will be able to

1.The concept and application of energy and green chemistry for minimization of wastes and environmentally balanced industrial complexes.

2.To know the renewable and non-renewable energy resources and its significance.

3.The application of energy and green energy, green nano particle, and biocompatibility for resource conservation, ecosystems, non-medical applications and human being.

4.The use of green chemistry in industries, fuel cell, solar energy, electric vehicles, solar photovoltaic technology and in biofuel production etc.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test/Tutorials/seminar	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
Total Credits	:-	02	**Total Marks**	:-	50

Course Outcome

Students should be able to:

1.Define the concept and application of energy resources and green technology for minimization of wastes and environmentally balanced industrial complexes.

2.Understand the renewable and non-renewable energy resources and its significance to improve performance of the products in environment

3.Apply the concept of energy and green nanotechnology, nano particles and biocompatibility for resource conservation, ecosystems, non-medical applications and human being.

4.The applications of energy and green chemistry in industries, fuel cell, solar photovoltaic technology and in bio fuel product etc.

oduleNo.	**Topics / actual contents of the syllabus**	**Contact Hours**
I	**Introduction:** Energy Resources – Concept, Definition, types of energy resources Energy resources: Growing energy needs, renewable and non-renewable energy resources, Renewable energy resources: Solar energy: Passive and active solar heating system, Concept of Solar Cells, Advantages and limitations Hydropower: Principle, potential, benefits and limitations.	**10 Hrs**

II	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, use of alternate energy sources. **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.	**10 Hrs**
III	**Concepts and tools of Green Technology:** Concept of green chemistry, chemistry of the atmosphere, principles of sustainable and green chemistry, basic principles of green technology, concepts of atom economy & carbon trading, tools of green technology, waste minimization and climate change. **Green technology applications**: Green chemistry in industries, fuel cell and electric vehicles, solar energy and hydrogen production, energy from alternate sources, solar photovoltaic technology, biofuel production (bio-ethanol and biodiesel), biomass, prevention/minimization of hazardous /toxic products, agricultural related practices and food processing.	**11**

Reference Books:

1.Environmental Encyclopaedia, Jaico Publ. Hpise, Mumbai, 1196p

2. De A.K., Environmental Chemistry, Wiley Western Ltd.

3. Down to Earth, Cebtre fir Scuebce and Environment (R)

4. Raut P.D., Environmental Studies, Shivaji University Press, 2021

5.Gleick, H.,1993, Water in crisis, Pacific Institute for studies in

6.Dev., Environment & Security. Stockholm Env. Institute. Oxford Univ. Press 473p

7. Hawkins R.e., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R) Heywood, V.H.& Watson, R.T.1995, Global Biodiversity Assessment Cambridge Univ. Press 1140p.

8.Jadhav, H.& Bhosale, V.M.1995, Environmental Protection and Laws, Himalaya

Pub. Hcuse, Delhi 284p.

9.Mickinney, M.L.& School. R.M.1196, Environmental Science Systems &

Solutions, Web enhanced edition, 639p.

10.M.H. Fulekar (2010) Nanotechnology Importance and application, I K international publishing house Pvt.Ltd.

11.Lynn Goldman, Cristine Cousens, Implications of nanotechnology for environmental health research National Academic Press, Washington, 2007.

12.Matlack, A.S. Introduction to Green Chemistry, Marcel Dekker: New York, 2001.

13.Anastas P.T. Warner, J.C. Green chemistry: theory and Practice. Oxford Univ.Press: oxford,1998.

14.Lynn E Foster: Nanotechnology: Science, Innovation, and Opportunity, December 21, 2005, Prentice Hall.

B.Sc. Second Year; Semester – IV
Subject: Environmental Science
Minor - ENS/Mn/T/251

Emerging Technologies for Treatment of Waste Water

(Minor Theory Course with 02 credit, 30 Contact Hours)

Course Objectives:

1. To provide fundamental knowledge of wastewater characteristics and conventional treatment methods.
2. To introduce students to advanced and emerging technologies in wastewater treatment.
3. To develop an understanding of sustainable, smart, and resource-efficient treatment approaches.
4. To familiarize students with recent innovations, case studies, and policy frameworks.
5. To encourage critical thinking on selecting appropriate treatment technologies for varied wastewater types.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit I: Fundamentals of Wastewater and Treatment Technologies 10 hrs.

- Introduction to wastewater: Sources, types, and characteristics
- Physical, chemical, and biological parameters of wastewater
- Conventional treatment methods:
  - Preliminary, primary, secondary, and tertiary treatment
- Limitations of traditional treatment methods
- Need for emerging technologies in wastewater management

Unit II: Advanced and Emerging Wastewater Treatment Technologies 10 hrs

- **Membrane Technologies:**
  - Microfiltration, ultrafiltration, nanofiltration, and reverse osmosis
- **Advanced Oxidation Processes (AOPs):**
  - Ozonation, UV/H_2O_2, Fenton reaction
- **Biological Innovations:**
  - Moving Bed Biofilm Reactor (MBBR)
  - Membrane Bioreactor (MBR)
  - Algal-bacterial symbiosis
- **Electrochemical Technologies:**
  - Electrocoagulation, electro-oxidation

Unit III: Sustainable & Smart Wastewater Treatment Approaches 10 hrs.

- **Green technologies and nature-based solutions:**
  - Constructed wetlands, phytoremediation, biosorption
- **Resource Recovery and Circular Economy:**
  - Nutrient recovery (N, P)
  - Water reuse and recycling strategies
- **Smart Technologies:**
  - IoT and AI in wastewater monitoring and control
  - Automation and real-time analytics
- Policy, regulation, and environmental standards in wastewater treatment (CPCB norms)

Course Outcome (Cos):

By the end of this course, students will be able to:

1. Describe the characteristics of wastewater and explain conventional treatment methods.
2. Evaluate and compare various emerging wastewater treatment technologies (e.g., membrane, AOPs, MBBR).
3. Apply principles of sustainability to assess green and nature-based treatment solutions.
4. Analyze the role of digital tools such as IoT and AI in modern wastewater management.
5. Interpret relevant environmental regulations, standards, and best practices for wastewater reuse.
6. Propose appropriate technology-based solutions for specific wastewater scenarios.

Book References:

11. **Metcalf & Eddy.** (2014). *Wastewater Engineering: Treatment and Resource Recovery*, 5th Edition, McGraw-Hill Education.
12. **Tchobanoglous, G., Burton, F. L., & Stensel, H. D.** (2003). *Wastewater Engineering: Treatment and Reuse*. McGraw-Hill.
13. **Binnie, C., Kimber, M., & Smethurst, G.** (2013). *Basic Water Treatment*, 5th Edition, ICE Publishing.
14. **UNESCO.** (2020). *Wastewater: The Untapped Resource*. UN World Water Development Report.
15. **I. B Ghorude, S.N. Bansal & Dharmendra,** Environmental Science, Scientific International publication house. Tamilnadu.
16. **S.N. Kaul** and **T.V. Ramachandra ,** *Environmental Management* New Age International Publishers, 2006.
17. **R. K. Trivedy** *Pollution Management in Industries* Enviro Media, 1995.

B.Sc. Second Year: Semester –IV
Subject: Environmental Science
OE/ GE Course: ENS/GE/OE/T/250
Environmental Statistics & Computer Application

Environmental Statistics & Computer Application

Total Credits: 02 **Total Contact Hours: 30 Hrs**
Maximum Marks: 50

Course Objective

Students will be able to

1.Apply the fundamental concepts of statistics in environmental analysis.

2.Know the concept of probability poison and binomial distribution for the application of environmental variables.

3.Explain the concept of statistics and application of probability to predict environmental situations.

4.Understand application of computer to interpret environmental data.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No. of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test/Tutorials/seminar	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
Total Credits	:-	02	**Total Marks**	:-	50

Course Outcomes

The end of the course, the student should be able to

1.Students will understand the fundamental concepts of statistics in environmental analysis.

2.Use of the computer application and statistics for future research and monitoring programmes in environment, climate and ecology sector.

3.Students will be able to judge the appropriate methods for the data analysis.

4.Students will be able to develop skills required for the interdisciplinary problems and searching solution through multidisciplinary learning in environmental science.

oduleNo.	**Topics / actual contents of the syllabus**	**Contact Hours**
I	**Unit - I: - Fundamental Concepts of Statistics in Environment**Concept of Statistical sampling, Principles of sampling, Merits of sampling, Basics and types of samplings, Simple random sampling, Stratified random sampling, Systematic sampling, Multistage sampling. Measures of central tendency-mean and its types, Median, mode.	**10 Hrs**
II	**Unit-II-Application of Probability in environmental data:** Basic Concept of probability - Addition and multiplication theorem of probability, Conditional probability and unconditional probability, Problems on probability depending on environmental systems data or data of environmental case studies.	**10 Hrs**

III	**Unit- III: -Computer applications in environmental science** Introduction to computer, Computer organization, Concept of software and hardware, Functions, Capabilities and limitations of computers, use of computer in environmental Science, Applications of Windows XP, MS Word, MS Excel, MS Power Point, Adobe Page Maker in environmental science, Use of internet in environmental science, Applications of computer in environmental science.	**10**

Reference Books:

1.Bodkin, Daniel D. (1995). Environmental Science- Earth as a Living Planet, John Wiley & Sons, New York.

2.Clark, C.W. (1976). Mathematical Bioeconomics: Optimal Management of Renewable Resources, John

3.Gore, Anil and Paranjpe, S.A. (2000). A Course on Mathematical and Statistical Ecology, Kluwer Jorgensen, Environmental Modeling.

5.Ludwig, J.A. and Judwig, J.F. (1988). Statistical Ecology, Wiley and Sons, New York.

6.Pielou, E.C. (1997). An Introduction to Mathematical Ecology, John Wiley and Sons, New York.

7.Ray, Devraj (1998). Development Economics, Oxford University Press, Oxford.

8.Snape and Dunn, Dynamics of Environmental Bioprocesses-modelling and simulation.

9.Sen, A. (1997). Poverty and Inequality, Oxford University Press, Oxford.

10.Smith, J. M. (1982). Evolution and the Theory of Games, Cambridge University Press, Cambridge.

B.Sc. Second Year: Semester –IV
Subject: Environmental Science
OE/ GE Course: ENS/GE/OE/T/251

Industrial Safety & Health Hygiene

(Theory Course with 02 credit)

Course Objectives:

1. To provide a foundational understanding of industrial safety, hazard types, and risk assessment.
2. To introduce the principles and practices of occupational health and industrial hygiene.
3. To create awareness about health hazards, control measures, and personal protective strategies in the workplace.
4. To familiarize students with national safety legislation, codes, and management systems.
5. To develop skills to evaluate and manage safety and hygiene practices in industrial environments.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semister	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/Semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit I: Introduction to Industrial Safety and Risk Management 10 hrs.

- Importance and scope of industrial safety
- Types of hazards: physical, chemical, biological, mechanical, ergonomic
- Hazard identification and risk assessment (HIRA)
- Accident causation theories and models
- Safety audit, safety inspection, and safety committees
- Fire safety, explosion hazards, and control measures

Unit II: Occupational Health and Industrial Hygiene 10 hrs

- Concept and objectives of occupational health
- Common occupational diseases: respiratory, skin, noise-induced hearing loss
- Personal Protective Equipment (PPE): types and applications
- Industrial hygiene: Definition, scope, and principles
- Industrial ventilation and indoor air quality
- Health surveillance and exposure assessment

Unit III: Safety Legislation, Management Systems and Best Practices 10 hrs

- Indian safety laws and regulations:
  - Factories Act, 1948
  - The Occupational Safety, Health and Working Conditions Code, 2020
- Safety management systems (OHSMS, ISO 45001)
- Behavioural-based safety (BBS) and safety culture
- Emergency preparedness and disaster management in industries
- Case studies: Bhopal gas tragedy, Vizag LG Polymer gas leak

Course Outcome (Cos):

By the end of this course, students will be able to:

1. Explain the fundamental concepts of industrial safety, types of hazards, and accident causation.
2. Identify workplace hazards and apply risk assessment techniques to manage them effectively.
3. Describe key elements of occupational health and industrial hygiene, including PPE and monitoring.
4. Interpret Indian laws and standards related to safety and health in industrial settings.
5. Assess industrial safety and hygiene practices through real-world case studies and propose solutions.
6. Demonstrate understanding of safety management systems and emergency response planning.

Book References:

10. **A.K. Gupta.** *Industrial Safety and Environment*, Laxmi Publications, 2006.
11. **K. U. Mistry.** *Fundamentals of Industrial Safety and Health*, Siddharth Prakashan, 2007.
12. **R.K. Jain and Sunil S. Rao.** *Industrial Safety, Health and Environment Management Systems*, Khanna Publishers, 2015.
13. **C.K. Singh Industrial** *Safety Management* Himalaya Publishing House, 2013.
14. **Goel, S.** *Environmental Guidelines and Standards in India* Allied Publishers, 2006.
15. **J.M. Deshpande** *Industrial Safety Handbook*, McGraw Hill India, 2012.

B.Sc. Second Year, Semester IVth
Subject: Environmental Science
ENS/SEC/T-250
Mineral Resources Management

Course Objectives:

Students will be able to know

1. To explore the classification, occurrence, and extraction of mineral resources.
2. To understand the economic importance of minerals in national development.
3. To analyze the environmental and social impacts of mining activities.
4. To study policies and regulatory frameworks governing mineral exploration and use.
5. To promote sustainable and responsible management practices in the mineral sector.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	2 hr/week	Continuous Internal Assessment by teacher	:-	20
Total No.of Lectures /Hours/ Semester	:-	30hr/Semester	Sem-End Examination	:-	30
Test	:-	5hr/semester	Marks for Passing (Internal + External exam)	:-	40%
	:-	02	Total	:-	50

Unit I: Introduction to Mineral Resources **10 hrs**

Introduction-Mineral Resources, formation of mineral, deposits types of Indian resources
Definition and classification of minerals: metallic, non-metallic, energy minerals.
Use of mineral resources conservation of mineral resources

Unit II: Environmental of Mining **10 hrs**

Surface mining impacts- Removal of vegetation, soil erosion, slope instability.
Air Pollution- Dust and particulate matter from blasting, drilling, loading, Emission of NOx, SO_2 from diesel machinery.
Water Pollution- Acid mine drainage (AMD) from sulphide-rich ores, Contamination of surface water and groundwater.

Unit III: Mineral Policy and Governance **10 hrs**

India's legislation on **mineral rights** is governed by a framework of national-level laws, rules, and policies.
Regulatory Institutions in India- Ministry of Mines, Indian Bureau of Mines (IBM), Geological Survey of India (GSI), State Directorates of Mining and Geology.

Course Outcomes

1. Understand the value of mineral resources.
2. Encourages policies and technologies that minimize waste, enhance recovery, and promote recycling.
3. Supports national development through resource evaluation policies.
4. Addresses pollution, land degradation, and biodiversity loss associated with mining activities.
5. Informs students about mineral laws, regulations, and governance frameworks essential for ethical and legal mining practices.

Textbooks and References:

1. B.K. Sharma, “Environmental Chemistry”, Goel Publishing House.
2. Ravi Jain (1999), “Environmental Impact of Mining”, CRC Press.
3. Samir Sinha, “Mining and Environment in India”, TERI Press.
4. P.K. Jain, H.L. Sinha, R.N. Gupta, “Mine Environment and Ventilation”, Oxford & IBH Publishing.
5. Government of India, “National Mineral Policy 2019”, Ministry of Mines. https://mines.gov.in/
6. Indian Bureau of Mines (IBM), Annual reports and mineral statistics.
7. UNEP Environmental Aspects of Mining.

B.Sc. Second Year: Semester –IV

Subject: Environmental Science
Skill Enhancement course: ENS/SEC/T-251
Environmental Tourism

Course objectives

Students will be able to know

1. This course is designed to impart knowledge and skill on understanding the Concepts of diversified Eco-tourism spots.
2. This will develop an understanding and comprehensive overview of how much important Nature is and being applied to address challenges and promote sustainable development for Environmental tourism.

Teaching Scheme			**Evaluation Scheme**		
Instruction hours/lectures	:-	1 hr/week	Continuous Internal Assessment by teacher	:-	10
Total No.of Lectures /Hours/ Semester	:-	15hr/Semester	Sem-End Examination	:-	15
Test	:-	2hr/semester	Marks for Passing (Internal + External exam)	:-	40%
Total Credits	**:-**	**01**	**Total Marks**	**:-**	**25**

Unit –I Introduction **to Ecotourism** **5 hrs**

History and scope of ecotourism; Components of ecotourism, Types of Ecotourism Tourism, Ecotourism; Types

Unit-II Agro-ecotourism **5 hrs**

Agro-ecotourism, Geo- ecotourism, Cultural ecotourism – tangible and intangible heritages and tourism, Sensitive areas of ecotourism, Ecotourism management plans, pollution source and its associated problems

Unit-III Ecotourism resources in India and Maharashtra **5 hrs**

Eco-regions; Vegetation types; Protected areas; biodiversity hotspots; Historical monuments and historical sites; Adventure ecotourism destinations; Ecotourism potential of Maharashtra.

Course Outcome:

After Completion of the Course, Students will be able to:

1. To provide clear understandings on theory and practices of marketing with special reference to tourism business.
2. To know various marketing aspects involved in eco-tourism industry.

Books Recommended:

1. Chaudhary, Manjula (2011). Tourism Marketing, Oxford University Press, New Delhi.
2. Bennett J. A., Strydom J.Wilhelm (2001). Introduction to Travel and Tourism Marketing, Juta Education, Lansdown.
3. Kotler P. (2012). Marketing Management, Pearson Education, New Delhi.
4. Stanton W. J. (1999). Fundamentals of Marketing, McGraw Hill, New York.
5. Neelamegham S. (1998).Marketing in India: Cases & Readings, Vikas, New Delhi.
6. Ramasamy V.S. &Namakumar S. (1990).Marketing Management: Planning & Control, Macmillan, New Delhi.
7. Stone, Marilyn A., Desmond, John(2007). Fundamentals of Marketing, Routledge, New York.
8. Majid Husain ,Geography of India IInd Edition 2011
9. K.Manikandan Indian Forestry 2010
10. Biogeography by Savindra Sing 2011

B.Sc. Second Year, Semester IVth

Subject: Environmental Science
ENS/SEC/P/ 276 (Practical based on ENS/SEC/T/250)

1. Determination of PM2.5 in air
2. Determination of PM10 in air
3. Determination of Sox in Air
4. Determination of NOx in Air
5. Determination of Heavy Metals
6. Dust Fall For measurement by tile method
7. Nearest Mining Site Visit to the Rock Mining Site prepare a report on Environmental Degradation
8. Nearest Mining Site Visit to the Sand Mining Site prepare a report on Exploitation and Degradation of Water Resource
9. Noise Measurement by Using dB meter
10. Study of Change Detection Report by using Google Earth Image.

B. Sc. Second Year: Semester –IV
Subject: Environmental Science
ENS/SEC/P/ 277 (Practical based on ENS/SEC/T/251)

List of Practicals:

1. Identify the spots for eco-tourism to nearby area.
2. Identify the different pollution source on eco-tourism spots.
3. Identify different types of flora and fauna in Gautala forest.
4. Field visit to nearby Biodiversity Park.
5. Measuring plant diversity by quadrate method.
6. Study of different historical monuments of Maharashtra.
7. Study of Environmental tourism management.
8. Types of solid waste generated on eco-tourism spots.
9. Study of safety measures during different eco-tourism.
10. Report writing / Seminar