



Anekant Education Society's
Tuljaram Chaturchand College, Baramati.
(Autonomous)
(Faculty of Science & Technology)

T.Y.B.Sc. (Environmental Science) Semester -VI
For Department of Environmental Science
Tuljaram Chaturchand College, Baramati.

Programme Specific Outcomes (PSOs)

PO1: Disciplinary Knowledge: Demonstrate comprehensive knowledge of the disciplines that form a part of a graduate programme. Execute strong theoretical and practical understanding generated from the specific graduate programme in the area of work.

PO2: Critical Thinking and Problem solving: Exhibit the skills of analysis, inference, interpretation and problem-solving by observing the situation closely and design the solutions.

PO3: Social competence: Display the understanding, behavioral skills needed for successful social adaptation, work in groups, exhibit thoughts and ideas effectively in writing and orally

PO4: Research-related skills and Scientific temper: Develop the working knowledge and applications of instrumentation and laboratory techniques. Able to apply skills to design and conduct independent experiments, interpret, establish hypothesis and inquisitiveness towards research.

PO5: Trans-disciplinary knowledge: Integrate different disciplines to uplift the domains of cognitive abilities and transcend beyond discipline-specific approaches to address a common problem

PO6: Personal and professional competence: Performing dependently and also collaboratively as a part of a team to meet defined objectives and carry out work across interdisciplinary fields. Execute interpersonal relationships, self- motivation and adaptability skills and commit to professional ethics.

PO7: Effective Citizenship and Ethics: Demonstrate empathetic social concern and equity centred national development, and ability to act with an informed awareness of moral and ethical issues and commit to professional ethics and responsibility.

PO8: Environment and Sustainability: Understand the impact of the scientific solutions in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.

PO9: Self-directed and Life-long learning: Acquire the ability to engage in independent and life-long learning in the broadest context of socio-technological changes.

**Anekant Education Society's
Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati
(Autonomous)**

SYLLABUS (CBCS) FOR T.Y.B.Sc. Environmental Science Syllabus

Class	Semester	Paper Code	Paper Title	Credit
T.Y.B.Sc.	V	EVS 3501	Ecosystem Management	3
		EVS 3502	Wildlife Biology	3
		EVS 3503	Geoscience	3
		EVS 3504	Nature Conservation	3
		EVS 3505	Environmental Governance, Laws and Ethics	3
		EVS 3506	Environmental Biotechnology	3
		EVS 3507	Practical based on EVS3501 and EVS3502	2
		EVS 3508	Practical based on EVS3503 and EVS3504	2
		EVS 3509	Practical based on EVS3505 and EVS3506	2
	VI	EVS 3601	Climate Change	3
		EVS 3602	Analytical Methods	3
		EVS 3603	Sustainable Development	3
		EVS 3604	Environmental Statistics	3
		EVS 3605	Environmental Safety and Risk Management	3
		EVS 3606	Environmental Economics And Audit	3
		EVS 3607	Practical based on EVS 3601 to EVS 3603	2
		EVS 3608	Practical based on EVS 3604 to EVS 3606	2
		EVS 3609	Project	2

Semester-VI

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3601**
Paper: **I** Title of Paper: **Climate Change**
Credit: **3** No. of lectures: 48

A) Learning Objectives:

- 1) Understand the anthropogenic and natural drivers of climate change and future developments aspects for the sustainability
- 2) Identify and evaluate the environmental, social, and economic impacts of anthropogenic activities and required sustainability framework for mitigation of the same.
- 3) Realize scope, importance, and opportunities for climate change studies.

B) Course Outcome:

- 1) Sensitize about Impacts of climate change and future goals and of sustainability.
- 2) Aware of various policies and agreements regarding these two aspects.
- 3) Understand Methodologies for impact assessments and current practices of the societies.
- 4) Help us understand why global temperatures continue to rise, how the climate affects us, and how we can tackle this challenge before things get much worse.
- 5) Students will be able to define climate change.
- 6) Students will be able to analyze the global impact of climate change.
- 7) Students will be able to outline the process of climate change.

Credit-I (16L)**Unit-1- Climatic Systems and Variations**

- Global Climate System, Causes for Modern Climate Change.
- Internal Variability: Ocean-Atmosphere Variability, Ocean Currents
- External Climate Forces: Greenhouse Gases, Orbital Variations, Solar Fluctuations, Volcanism, Plate Tectonics
- Evidence and Measurement of Climate change
- History and Evolution of Green Gases (8L)

Unit-2- Consequences and Challenges

- Impacts on Life, Flora and Fauna
- Glaciers and Ice Sheets Melting- Sea Level Changes, Economics of Climate Change, Climate Change and Water Scarcity, Coastal Ecosystem and Vulnerability, Threats to Forest and Biodiversity, Energy Generation and Climate Change Mitigation.
- Agriculture and Food Security, Carbon Sequestration, Climate Change in agriculture and health. (8L)

Credit –II (16L)**Unit-1 International Organization for Climate Change**

- Extreme Events and Disasters, International Efforts, UNFCCC and Conference of the Parties, Special Reports by IPCC, Kyoto Protocol and Agreements (G-7, G-17), Copenhagen Conference, Glasgow Conference, Role of NGO's. (8L)

Unit-2 Confronting Climate Change:

- Policies and Efforts-
India: National Action Plan on Climate Change (NAPCC),
State Action Plan on Climate Change (SAPCC),
National Adaptation Fund on Climate Change (NAFCC),
Climate Change Action Programme (CCAP),
Long Term Ecological Observatories (LTEO) Programme. (8L)

Credit-III (16L)

Unit-1 Mitigation Approaches in Climate Change

Climate and Weather Statistics,
Climate Change Modeling,
Carbon Emissions Reduction Technologies,
Climate Change Research,
Climatology Journals and Top Institutions. (8L)

Unit-2 Governance of Climate Change

Governance for Climate Change,
Clean Development Mechanism,
Technology Options Fuel Switching and Carbon Sequestration,
Regional, National and International Experiences. (8L)

Reference:-

- The Climate Fix: What Scientists and Politicians Won't Tell You About Global Warming by Roger Pielke, Basic Books (2010)
- The Climate Solution: India's Climate Change Crisis and What We Can Do About It by Mridula Ramesh, Hachette India (2018).
- This Changes Everything: Capitalism vs. the Climate by Naomi Klein, Penguin (2015).
- What Is Climate Change? (What Was?) by Gail Herman (Author), Illustrated by John Hinderliter, Penguin Workshop (2018).
- Climate Change Biodiversity and Green Economy by H.S. Sharma S. Padmaja and Ganesh Sharma, Concept Publishing Company Pvt. Ltd. (2013).
- Climate Change by Joseph Romm, OUP US (2018).

Mapping of Program Outcomes with Course Outcomes

Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1								3	
CO2							3		

CO3				3					
CO4		3							
CO5	3								
CO6			3						
CO7					3				

Justification for the mapping

PO1: Disciplinary Knowledge:

CO5.Students will acquire foundational knowledge about climate change.

PO2: Critical Thinking and Problem solving:

CO4.Students will develop critical thinking skills to understand the causes of global temperature rise and explore solutions to tackle climate change challenges.

PO3: Social competence:

CO6.Students will develop social competence by understanding the global implications of climate change.

PO4: Research-related skills and Scientific temper:

CO3.Students will acquire skills in understanding methodologies for impact assessments and current societal practices related to climate change.

PO5: Trans-disciplinary knowledge:

CO7. Students will gain trans-disciplinary knowledge by understanding the interconnected processes involved in climate change.

PO7: Effective Citizenship and Ethics:

CO2.Students will be aware of various policies and agreements related to climate change and sustainability, contributing to effective citizenship.

PO8: Environment and Sustainability: CO1.Environment and Sustainability: Students will gain knowledge and understanding of the impacts of climate change and future goals of sustainability.

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3602**
Paper: **II** Title of Paper: **Analytical Methods**
Credit: **3** No. of lectures: 48

A) Learning Objectives:

- 1) To learn analytical and physico-chemical methods.
- 2) To learn estimation of elements techniques.
- 3) To learn chemistry of biologically important molecules.

B) Course Outcome:

Upon successful completion, students will have the knowledge and skills to:

1. Explain the theoretical aspects of key analytical techniques and instruments used in geochemistry, including but not limited to electron microscopy, X-ray diffraction, mass spectrometry and spectroscopy (including synchrotron techniques).
2. Strategically plan analytical campaigns to apply to different types of samples and research objectives, including selection of the most appropriate technique/instrumentation for the students' research project.
3. Undertake the correct sample preparation and characterization prior to analysis by the chosen techniques or instruments.
4. Design an analytical work-flow to acquire data and achieve the research objectives of their project.
5. Process data from the chosen instruments and demonstrate understanding of the limitations and quality of the data. Justify the approach taken to data processing.
6. Write a clear and concise justification and description of the analytical techniques employed, suitable for publication in a scientific journal.
7. Students will understand the physiological functions that regulate the proper growth and development of living things.
8. Express the role of analytical chemistry in science.

Credit-I (16L)**Unit-1 Analytical Instrumentation**

•Estimation of various elements at major, minor trace, ultra trace level concentrations:

Choice of a technique and its principles, merits and demerits of the techniques –

- 1) Neutron Activation Analysis,
- 2) Spectrophotometry,
- 3) Colorimetry,
- 3) Atomic absorption spectroscopy,
- 4) ICPAES, gas chromatography, HPLC,
- 5) Ion exchange chromatography, X-ray fluorescence, X-ray diffraction,
- 6) Flame photometry and polarography.

(16L)

Credit-II (16L)**Unit-1 Introduction to Soil Chemistry.**

Definition of soil, life on soil, composition of soil,
 Mineral matter in soil, organic matter in soil, soil respiration,
 Process of soil formation, factors affecting soil, soil profile,
 Soil microorganisms,
 Types of soils, micro and macro plant nutrients, nutrient functions. (8L)

Unit-2 Chemistry of Water:

Unusual physical properties, hydrogen bonding in biological systems,
 Unusual solvent properties, changes in water properties by addition of solute. (8L)

Credit-III (16L)

Unit-1 Chemistry of Biologically Important Molecules

Protein structure and biological functions, enzymes, enzyme metabolism, biosynthesis of DNA and RNA.

Chemistry of hydrocarbon decay, environmental effects, effects on macro and micro organisms
 Surfactants.

Cationic, anionic and nonionic detergents, modified detergents.

Lead and its compounds: Physical and chemical properties, behavior, human exposure, absorption, influence. (8L)

Unit-2 Residual Effect of Hazardous Substances and Their Properties:

Definition, characterization, UN classification, Identification,

Chemistry of Various Organic and Inorganic Compounds.

Carcinogenic compounds and their effects,

Acid halides and anhydrides, alkali metals,

Cyanides, Isocyanides and cyanogens bromides, chromium, halogenated compounds. (8L)

Reference:-

- Environmental Chemistry- A.K.Dey New Age International publishers
- Destruction of hazardous chemicald- G.Lunn, E.B.Sandome
- Hazardous substances in chemical lab-G.D.MuMivir
- Essentials of Nuclear Chemistry, H. J Arnikar, Wiley Eastern Limited, 4th Edition.(1995) Course no. Title Credits Semester I
- Instrumental methods of analysis-Chatwal and Anand

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Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3								
CO2		3							
CO3				3					
CO4						3			

CO5		3							
CO6					3				
CO7				3					
CO8	3								

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1.Students will acquire in-depth knowledge of analytical techniques in geochemistry, contributing to their disciplinary expertise.

CO8.Understanding the role of analytical chemistry enhances disciplinary knowledge.

PO2: Critical Thinking and Problem solving:

CO2.Students will enhance critical thinking skills by planning and selecting analytical techniques based on research objectives.

CO5.Critical thinking skills will be enhanced through understanding data limitations and quality.

PO4: Research-related skills and Scientific temper:

CO3.Students will develop research-related skills, including accurate sample preparation, contributing to a scientific temper.

PO5: Trans-disciplinary knowledge:

CO7.Students will gain understanding of physiological functions related to growth and development.

PO6: Personal and professional competence:

CO4.Students will develop professional competence by designing effective analytical workflows.

CO6.Students will develop communication skills to write clear justifications and descriptions of analytical techniques.

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3603**
Paper : **III** Title of Paper : **Sustainable development**
Credit : **3** No. of lectures : 48

A) Learning Objectives:

- 1) To learn or study the Concept of Sustainable Development
- 2) To make student aware about conservation natural resources.
- 3) To learn Goals of Sustainable Development.

B) Course Outcome:

- 1) Students will be able to define sustainability and identify major sustainability challenges.
- 2) Students will have an understanding of the carrying capacity of ecosystems as related to providing for human needs.
- 3) Students will be able to apply concepts of sustainable development to address sustainability challenges in a global context.
- 4) Students will identify, act on, and evaluate their professional and personal actions with the knowledge and appreciation of interconnections among economic, environmental, and social perspectives.
- 5) Students will have an understanding of their social responsibility as future professionals and citizens.
- 6) Students will be able to analyze power, structures of inequality, and social systems that govern individual and communal life.
- 7) Students will be able to recognize the global implications of their actions.

Credit-I (16L)

Unit- 1 Introduction

Origins of Sustainable Development: Definition, Evolution and Principles,
Strategies for Sustainable Development,
Sustainability and Human Development.

(8L)

Unit -2 Goals and Issues

UN Sustainable Development Knowledge Platform,
Tools for Sustainable Development,
Sustainable Development Goals,
Communicating the Sustainable Development Goals,
Criticisms in Sustainability,
Women and Gender Equality,
Roll of women and youth in environmental protection. (8L)

Credit-II (16L)**Unit -1 Environmental Conservation and Sustainability**

Technical Skills in Environment and Sustainability,
Preservation of Biological Diversity,
Sustainable Forest Management,
Challenges in Energy, Food and Agriculture. (8L)

Unit- 2 Recent Trends in Sustainability

Appropriate Technology and Sustainability Science,
Consumption and Production Patterns,
Sustainable Transport,
Corporate Sustainability,
Ecological and Carbon Footprint for Sustainability Measurement,
Sustainability Measurement and Reporting Tools,
Sustainability in Policy Design. (8L)

Credit-III (16L)**Unit -1 Management and Strategies**

Cultural Elements in Sustainable Development Frameworks,
Human Centered Designs in Sustainability,
The 2030 Agenda.
Environmental management and innovation strategies. (8L)

Unit -2 Green Building

Introduction, Features, Goals, design, material and energy efficiency, Examples, Impacts,
Role of Green building in environmental protection,
The Indian Green Building Council (IGBC). (8L)

Reference:-

- 1) Chauturvedi .P.(2003), Energy, Environment and Sustainable Development, Concept Publishing Company, New Delhi
- 2) Environment and Sustainable Development by M.H. Fulekar, Bhawana Pathak, R K Kale,

- Springer Nature (2013).
- 3) Sustainable Development in Digital Era by Dr. Aparna Mishra, Dr. Vikas Dahiya, Dr. Kamini Tandon, JSR Publishing House LLP; (2019).
 - 4) The Age of Sustainable Development by Jeffrey D. Sachs and Ban Ki –moon, Columbia University Press (2015).
 - 5) Target 3 Billion: Innovative Solutions Towards Sustainable Development by APJ Abdul Kalam, Srijan Pal Singh, Penguin India (2011)

Mapping of Program Outcomes with Course Outcomes

Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3								
CO2					3				
CO3		3							
CO4						3			
CO5							3		
CO6			3						
CO7								3	

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1.Students will gain disciplinary knowledge in sustainability; they will define sustainability and identify key challenges.

PO2: Critical Thinking and Problem solving:

CO3.Students will apply sustainable development concepts to address global challenges; Application of sustainable development concepts enhances critical thinking skills.

PO3: Social competence:

CO6.Students will analyze power, structures of inequality, and social systems, analyzing social structures contribute to social competence.

PO5: Trans-disciplinary knowledge:

CO2.Understanding carrying capacity contributes to a trans-disciplinary perspective on sustainability.

PO6: Personal and professional competence:

CO4. Students will identify, act on, and evaluate actions considering economic, environmental, and social interconnections, Evaluation of actions with a holistic perspective contributes to personal and professional competence.

PO7: Effective Citizenship and Ethics:

CO5. Understanding social responsibility contributes to effective citizenship and ethical behavior.

PO8: Environment and Sustainability:

CO7. Recognizing global implications aligns with the program outcome on environment and sustainability.

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3604**
Paper: **IV** Title of Paper: **Environmental Statistics**
Credit: **3** No. of lectures: 48

A) Learning Objectives:

Student should be able to

- 1) Compute various measures of central tendency, dispersion, skewness and kurtosis
- 2) Understand basic concepts of probability

B) Learning Outcome:

At the end of this course students are expected to be able:

- 1) To find the probabilities of various events.
- 2) Compute various measures of central tendency, dispersion, moments, skewness and kurtosis.
- 3) Compute correlation coefficient, regression coefficients and to interpret the results.
- 4) Compute the correlation coefficient for bivariate data and interpret it.
- 5) To fit linear, parabolic and exponential curves to the bivariate data to investigate relation between two variables.
- 6) It helps to students to environmental problems in terms of mathematical modeling to understand the impact of the chosen variables under study and show the direction of change in positive or negative manner

- 7) Allowing researchers to gain an understanding of environmental issues through researching and developing potential solutions to the issues they study.

Credit-I (16L)

Unit-1 Population and Sample (6L)

- 2.1 Types of data: Primary data, secondary data
 2.2 Notion of a sample and a random sample.
 2.3 Methods of sample (Description only) :Simple random sampling with and without replacement (SRSWR and SRSWOR), stratified random sampling, systematic sampling, cluster sampling and two-stage sampling.

UNIT 2: Univariate data analysis (10L)

Classification: Raw data and its classification, ungrouped frequency distribution, Sturges'rule ,method of classification inclusive and exclusive, open end classes, grouped frequency distribution ,cumulative frequency distribution, relative frequency distribution

Measures of Central Tendency: Concept of central tendency.

Arithmetic Mean (AM), Median, Mode.

Graph and Diagram; Histogram, Frequency polygon, Ogive curve, Box plot

Measures of Dispersion: Concept of dispersion

Range, Variance and standard deviation, Coefficient of variation (CV)

Credit-II (14L)

UNIT 4: Moments, Skewness and Kurtosis (6L)

Raw moments (μ_r'), Central moments(μ_r)

Relations between central moments and raw moments, up to 4th order

Concept of skewness and Kurtosis of frequency distribution

UNIT 5: Correlation and Regression (8L)

Bivariate data, Scatter diagram.

Concept of correlation between two variables, positive correlation, negative correlation, no correlation. Interpretation of correlation using scatter diagram.

Regression : Linear and nonlinear regression models. Fitting of regression line ($Y = a + bX$), and Fitting of second degree curve ($Y = a + bX + cX^2$), Fitting of exponential curves of the type $Y = ab^X$ and $Y = aX^b$.

Credit-I (16L)

UNIT 6: Sample Space, Events and Probability (10)

Concepts of experiments, deterministic and nondeterministic experiments.

Definitions: Sample space, Types of sample space, Event, Types of Events:
 Elementary event, Complementary event, sure event, impossible event.
 Concept of occurrence of an event, Equally-likely events, Algebra of events (Union,
 Intersection, Complementation), Definitions of Mutually exclusive events,
 Exhaustive events.
 Classical definition of probability, examples.

UNIT 7: Statistical Models in environmental Science (8)

Population Growth Model, Catch Model. Cohort Projections, Pope's Approximation

References:

1. Gupta and Kapoor : Fundamentals of Mathematical Statistics, Sultan Chand and Sons, New Delhi.
2. Sarma K.V.S.(2001)Statistics made it simple: Do it your self on PC. Prentce Hall of India, New Delhi.
3. B.L.Agarwal: Programmed Statistics, New Age International Publishers ,New Delhi.

Mapping of Program Outcomes with Course Outcomes

Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1				3					
CO2		3							
CO3					3				
CO4					3				
CO5								3	
CO6								3	
CO7				3					

Justification for the mapping

PO2: Critical Thinking and Problem solving:

CO2.Critical thinking is enhanced through the application of statistical measures to real-world problems.

PO4: Research-related skills and Scientific temper:

CO1.Probability calculations involve statistical skills contributing to scientific temper.
CO7.Students will gain an understanding of environmental issues and develop potential solutions through research, Research skills are applied to gain insights into environmental issues.

PO5: Trans-disciplinary knowledge:

CO3.Application of statistical techniques contributes to trans-disciplinary knowledge.

CO4.Understanding correlations in bivariate data contribute to trans-disciplinary knowledge.

PO8: Environment and Sustainability:

CO5.Investigating relationships between variables contribute to understanding environmental issues and sustainability.

CO6.Analyzing environmental problems through mathematical modeling align with the program outcome on environment and sustainability.

Class	:	T. Y. B. Sc. (Semester - VI)
Paper Code	:	EVS 3605
Paper: V		Title of Paper: Environmental Safety and Risk Management
Credit: 3		No. of lectures: 48

A) Learning Objectives:

- 1) To learn basics of Environmental risk and their management.
- 2) To learn methods of chemical risk assessment.
- 3) To learn information about hazard identification and risk management.

B) Course Outcome:

After studying this course, you should be able to:

- 1) Define risk in the most appropriate way, and appreciate the need to prioritize risks.
- 2) Appreciate the costs of illness associated with workplace activities.

- 3) Describe in outline the development of models used to explain the cause of incidents and to promote prevention.
- 4) recognize the multiple causes contributing to many incidents, and be able to represent them diagrammatically
- 5) Illustrate the components of an integrated management system.
- 6) Understand the general knowledge of good laboratory safety practices and the laboratory safety rules.
- 7) Evaluate Standard Operating Procedures (SOPs) and safety plans for handling dangerous samples, equipments and chemicals.
- 8) Ability to handle experimental data using statistical tools/methods.

Credit-I (16L)**Unit-1 Introduction to Environmental Risk**

Environmental safety: Definition, Goals, Introduction, objectives.

Categorization of Industries (Red, Orange, Green, White) (MPCB)

Concept of Risk and risk identification,

Risk assessment and risk communication,

Allocation and mitigation strategies,

Potential of health risks in industrial and development processes. (8L)

Unit-2 Risk Management

Local and national policies, public awareness and participation in prevention procedures,

Industrial environmental conditions,

Emissions and noise abatement,

Ecological risk assessment. (8L)

Credit-II (16L)**Unit-1 Fire Risk**

Introduction –Definition, History of fire services, Chemistry and physics of fire. Classification of fire. Causes, Detection and management.

The regulatory Reform (Fire safety) order 2005, Fire hazard and Risk.

Fire control technologies. Fire Audit. (8L)

Unit-2 Fire Risk Assessment

Fire Risk Assessment structure and Layout, means of escape principals: Basic requirements and what to look for, Fire signage: National requirements, Fire alarms and fire detection: Basic components, Testing, Emergency lighting: when it's required, basic components and testing. (8L)

Credit-III (16L)**Unit-1 Chemical Risk Assessment**

Importance of Chemical Safety, Basic laboratory rules and Safety.

Personal Protective Equipment (PPE),

Toxic Substances: Definition, Classes of toxicity, Entry points of Toxic agents, Effects of Toxic substances.

Chemical process safety –Decomposition and Runway Reactions, Reactive chemical hazard.

Chemical safety technologies. Case study in India. (8L)

Unit-2 Hazard Identification and Risk Management

The Process of Risk Management , Hazard Identification , Evaluation (Risk Assessment , Risk Matrix), Risk Control implementation, action and recommendation. (8L)

Reference:-

- 1) Computerized environmental modelling – J. Hardstay, DM Tailor & SE Metcalf
- 2) Computerized aided environmental management – SA Abbassi and FI Khan.
- 3) Environmental Governance: The Global Challenge; By Lamont C. Hempel; Island Press (1996)
- 4) Environmental Issues in India – A Reader; By Mahesh Rangrajan; Pearson-Longman Publ. (2007)
- 5) Handbook of Environmental Law, Acts, Guidelines, Compliances, and Standards: Vol. I and II; by R.K. Trivedy; BS publ (2004).
- 6) International Environmental Law, Fairness, Effectiveness and World Order; by Elli Louka, Cambridge, (2006)
- 7) Global Environmental Governance: A Reform Agenda; by Adil Najam, Mihaela Papa, and Nadaa Taiyab (2006), International Institute for Sustainable Development (IISD), Canada
- 8) Environmental Governance and Regulation in India: by *Atiyah Curmally*; (Environment and Rehabilitation) India Infrastructure Report 2002

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Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1		3							
CO2						3			
CO3				3					
CO4					3				
CO5								3	
CO6							3		
CO7							3		
CO8				3					

Justification for the mapping**PO2: Critical Thinking and Problem solving:**

CO1. Students will be able to define risk appropriately and prioritize risks; Critical thinking is applied in understanding and prioritizing risks.

PO4: Research-related skills and Scientific temper:

CO3. Students will describe the development of models for incident causation and prevention, Describing models involves research-related skills.

CO8. Students will demonstrate the ability to handle experimental data using statistical tools/methods; Statistical analysis is a research-related skill contributing to scientific temper.

PO5: Trans-disciplinary knowledge:

CO4. Recognizing multiple causes contributes to a trans-disciplinary understanding of risk management.

PO6: Personal and professional competence:

CO2. Students will appreciate the costs of illness related to workplace activities, Understanding the costs of illness contributes to personal and professional competence.

PO7: Effective Citizenship and Ethics:

CO6. Students will understand good laboratory safety practices and rules; Knowledge of laboratory safety contributes to effective citizenship and ethical behavior.

CO7. Students will evaluate SOPs and safety plans for handling dangerous materials, Evaluation of safety procedures aligns with effective citizenship and ethical behavior.

PO8: Environment and Sustainability:

CO5. Students will illustrate the components of an integrated management system, Understanding integrated management systems aligns with the program outcome on environment and sustainability.

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3606**
Paper: **VI** Title of Paper: **Environmental Economics and Audit**
Credit: **3** No. of lectures: 48

A) Learning Objectives:

- 1) To learn Environmental Economic and Development.
- 2) To learn Rural Planning and Development.
- 3) To learn Environmental valuation.

B) Course Outcome:

- 1) Students understood dimensions of natural Resources.
- 2) Students understanding the term Environmental Audit.
- 3) Students will acquire knowledge about to achieve rural development through the allocation and management of resources, mediated by develops mentalist configuration and local communities.
- 4) Have a detailed understanding of the disciplines of environmental economics including its key principles and methods.
- 5) Be able to use economic techniques to analyze environmental problems and to assess environmental policies.
- 6) Have a detailed understanding of the discipline of environmental economics, including its key principles and methods.
- 7) Be able to use economic techniques to analyze environmental problems and to assess environmental policies.
- 8) Have developed research skills in the field of environmental economics.

Credit-I (16L)

Unit-1 Meaning and need of Economic Environment

Economic and Development; Economic efficiency and Concept of Cost, Cost benefit analysis; concept of Consumerism; Poverty and globalization; Monitoring economic and environmental progress.

Factors influences economic environment.

Challenges in Indian Economy (8L)

Unit-2 Application of economics to improve environmental quality

Rural planning and development; Importance of rural economy in Development.

Environmental valuation (Hedonic pricing, Contingent valuation and Travel cost Method) and decision making; Agricultural environment, Factors Affecting agricultural Environment.

(8L)

Credit-II (16L)**Unit-1 Dimensions of Natural Resources**

Basic services of natural resources;
 Natural resources as a national capital;
 Natural resources and sustainable development;
 Resource economics;
 Issues and challenges of SEZ and EEZ in India.

(8L)

Unit-2 Environmental Audit

Basics of Environmental Audit and its need.
 Types of Environmental Audits
 Environmental Appraisal and Environmental Accounting
 Environmental Audit Procedure; Case studies.
 Green audit and energy Audit

(8L)

Credit-III (16L)**Unit-1 Environmental Management System (EMS)**

EMS definition, Environment Policy and components of EMS,
 Identification of environmental aspects and impacts,
 Legal and other requirements,
 Training and awareness requirements,
 Application of Environmental Standards -ISO standards and history of their development.

(16L)

Reference:-

Barthwal R.R. (2002): Environmental Impact Assessment, New Age International (P)Ltd .
 Pub New Delhi.
 Agrawal S.K.(2002) Pollution Management-(Vol-3),A.P.H publishing
 Gabriele Crognale P.C(1999).
 Environmental management strategies (The 21st century perspective) Printice Hall PTR
 Prabhakar V.K. (2001) Environmental Management. Anmol Publication pvt ltd.
 Kuhre W.L. (2000) ISO14031 Environmental performance evaluation EPE,Prentice Hall,
 PTR.Upper Saddle Rive.

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Course Outcomes	Programme Outcomes (POs)								
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3								
CO2				3					
CO3					3				
CO4	3								
CO5		3							
CO6	3								

CO7		3							
CO8				3					

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1. Understanding dimensions of natural resources contribute to disciplinary knowledge.

CO4. Students will have a detailed understanding of the disciplines of environmental economics, including key principles and methods; detailed understanding of environmental economics contributes to disciplinary knowledge.

CO6. Students will have a detailed understanding of the discipline of environmental economics, including key principles and methods; detailed understanding contributes to disciplinary knowledge.

PO2: Critical Thinking and Problem solving:

CO5. Students will demonstrate the ability to use economic techniques for analyzing environmental problems and assessing policies, Application of economic techniques involves critical thinking and problem-solving skills.

CO7. Students will demonstrate the ability to use economic techniques for analyzing environmental problems and assessing policies (repeated for emphasis), Application of economic techniques involves critical thinking and problem-solving skills.

PO4: Research-related skills and Scientific temper:

CO2. Students will have a clear understanding of the term "Environmental Audit." Understanding environmental audit involves research-related skills.

CO8. Students will have developed research skills in the field of environmental economics, developing research skills aligns with research-related skills and scientific temper.

PO5: Trans-disciplinary knowledge:

CO3. Students will acquire knowledge about achieving rural development through resource allocation and management. Understanding rural development involves a trans-disciplinary perspective.

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3607**
Paper : **Practical-I** Title of Paper : **Practical based on EVS 3601 to EVS 3603**
Credit : **2** No. of Practicals : **12**

A) Learning Objectives:

- 1) To learn controlling pollution in environment.
- 2) To learn different analytical methods.
- 3) To learn and controlling global warming.

B) Course Outcome:

- 1) Students understood handling of instruments.
- 2) Students understanding the basics for industrial purpose.
- 3) Student understanding the sustainable farming practices.
- 4) Students will reduce their reliance on non renewable energy, reduce chemical use and save scarce resources.
- 5) Students will aware to reduce pollution and waste reduction measures like reuse and recycling.
- 6) know the impacts that climate change is having on the natural environment;
- 7) understand how soil erosion may be made worse by climate change and could in turn lead to further climate change;
- 8) understand how climate change has the potential to exacerbate air pollution with potentially life threatening consequences;

Practical based on EVS 3601: Climate Change (04 Practicals)

- 1) Measurements for the impact of environmental stress conditions on plants.
- 2) Estimation of carbon sequestration.
- 3) Studies on plants facing pollutants from selected areas.
- 4) Impacts of extreme events in selected areas: A case study.

Practical based on EVS 3602: Analytical Methods (04 Practicals)

- 5) Estimation of COD.
- 6) Estimation of alkali metals in various samples by Flame-photometry
- 7) Estimation of heavy metals in soil samples by using AAS.
- 8) Estimation of oil and grease from given sample.

Visit: Visit to any Agricultural Research Institute and submission of report.

Practical based on EVS 3603: Sustainable development (04 Practicals)

- 9) Studies on measurements of sustainable farming practices
- 10) Measurement of sustainability by using innovative approaches and designs.
- 11) Designing of Green Building.
- 12) Measurement of carbon footprint of electricity.

Mapping of Program Outcomes with Course Outcomes

Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3								
CO2	3								
CO3								3	
CO4							3		
CO5							3		
CO6	3								
CO7					3				
CO8								3	

Justification for the mapping**PO1: Disciplinary Knowledge:**

CO1: Students will demonstrate understanding and proficiency in handling instruments, Instrument handling contributes to disciplinary knowledge.

CO6: Students will have knowledge of the impacts of climate change on the natural environment, Understanding climate change impacts contributes to disciplinary knowledge.

CO2: Students will understand the basics for industrial purposes, Understanding industrial basics involves critical thinking and problem-solving skills.

PO5: Trans-disciplinary knowledge:

CO7: Students will understand the relationship between climate change and soil erosion, recognizing the potential feedback loop, Understanding the interconnectedness of climate change and soil erosion contributes to trans-disciplinary knowledge.

PO7: Effective Citizenship and Ethics:

CO4: Students will demonstrate actions to reduce reliance on non-renewable energy, minimize chemical use, and conserve scarce resources, Taking actions to reduce environmental impact aligns with effective citizenship and ethical behavior.

CO5: Students will be aware of pollution and waste reduction measures, including reuse and recycling, Awareness and action towards waste reduction align with effective citizenship and ethical behavior.

PO8: Environment and Sustainability:

CO3: Students will comprehend sustainable farming practices, Understanding sustainable farming aligns with the program outcome on environment and sustainability.

CO8: Students will understand how climate change may worsen air pollution, leading to potential life-threatening consequences, Understanding the impact of climate change on air quality aligns with the program outcome on environment and sustainability.

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3608**
Paper: **Practical-II** Title of Paper: **Practical based on EVS 3604 to EVS 3606**
Credit: **2** No. of Practicals: 12

A) Learning Objectives:

- 1) To learn Environmental Economic and Development.
- 2) To learn the application of statistics in environment.
- 3) Student learns the safety rules.

B) Course Outcome:

- 1) Students understood the term Environmental Audit.
- 2) Student understood proper safety practices in chemical lab.
- 3) Student understood environment friendly concepts.
- 4) Students will understand how safety system works and risk management.
- 5) Emerging first aid at hazard site.
- 6) Allowing researchers to gain an understanding of environmental issues through researching and developing potential solutions to the issues they study.
- 7) To find the probabilities of various events.

Practical based on EVS 3604: Environmental Statistics (04 Practicals)

- 1) Grouping of data and preparation of frequency distribution, histogram and frequency polygon.
- 2) Calculating mean, median and mode for grouped and ungrouped data
- 3) Calculating variance, standard deviation and coefficient of variation, correlation coefficient for grouped and ungrouped data
- 4) Fitting simple linear regression. Plotting scatter diagram and regression line

Practical based on EVS 3605: Environmental Risk and Assessment management (04 Practicals)

- 5) To study the lab safety rules.
- 6) First aid treatment of fire and chemical hazards.
- 7) To study the types of fire alarm systems.
- 8) Designing and operating system of fire estimation.

Visit: Visit to any chemical industry/ fire and safety institute and submission of report.

Practical based on EVS 3606: Environmental Economics and Audit (04 Practicals)

- 9) Study of economical values of minimum five ecofriendly products.
- 10) To study the green audit/Energy Audit.
- 11) Preparation of questionnaires for waste management site.
- 12) Use of social media for e-networking dissemination of collection of ecofriendly Products/concepts.

Mapping of Program Outcomes with Course Outcomes

Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1	3								
CO2		3							
CO3								3	
CO4		3							
CO5							3		
CO6				3					
CO7					3				

Justification for the mapping

PO1: Disciplinary Knowledge:

CO1: Students will have a clear understanding of the term "Environmental Audit.", Understanding environmental audit contributes to disciplinary knowledge.

PO2: Critical Thinking and Problem solving:

CO2: Students will understand and adhere to proper safety practices in the chemical lab; Understanding and applying safety practices involve critical thinking and problem-solving skills.
CO4: Students will understand the functioning of safety systems and principles of risk management, Understanding safety systems and risk management involves critical thinking and problem-solving skills.

PO4: Research-related skills and Scientific temper:

CO6: Students will understand environmental issues and develop potential solutions through research, Researching environmental issues contributes to research-related skills and scientific temper.

PO5: Trans-disciplinary knowledge:

CO7: Students will demonstrate proficiency in finding probabilities of various events; Probability calculations involve statistical skills contributing to trans-disciplinary knowledge.

PO7: Effective Citizenship and Ethics:

CO5: Students will acquire knowledge about providing first aid at a hazard site; Knowledge of first aid aligns with effective citizenship and ethical behavior.

PO8: Environment and Sustainability:

CO3: Students will comprehend environment-friendly concepts, Understanding environment-friendly concepts aligns with the program outcome on environment and sustainability.

Class : **T. Y. B. Sc. (Semester - VI)**
Paper Code : **EVS 3609**
Paper: **Practical-III** Title of Paper: **Project Work**
Credit: **2** No. of lectures: -----

A) Learning Objectives:

- 1) To give information of research work.
- 2) To create awareness about innovative method.
- 3) To find out new conclusions through research.

B) Course Outcome:

- 1) Getting of awareness of innovative methodology.
- 2) Students will experience about innovative methodology to solve environmental problems.
- 3) In a specialization domain of his / her choice, student manager will be able to choose an appropriate topic for study and will be able to clearly formulate & state a research problem.
- 4) For a selected research topic, student manager will be able to compile the relevant literature and frame hypotheses for research as applicable.
- 5) For a selected research topic, student manager will be able to plan a research design including the sampling, observational, statistical and operational designs if any.
- 6) For a selected research topic, student manager will be able to compile relevant data, interpret & analyze it and test the hypotheses wherever applicable.
- 7) Based on the analysis and interpretation of the data collected, student manager will be able to arrive at logical conclusions and propose suitable recommendations on the research problem.
- 8) Student manager will be able to create a logically coherent project report and will be able to defend his / her work in front of a panel of examiners

Project Work

- 1) Compilation of data, typing, binding and submission of dissertation
- 2) Writing of research paper.
- 3) Power point presentation based on project work.

Mapping of Program Outcomes with Course Outcomes

Programme Outcomes (POs)									
Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
CO1						3		2	1
CO2								3	
CO3	3			2					
CO4	3	2							
CO5	3								
CO6	3								
CO7	3								
CO8	3	2		1		1			1

Justification for the mapping**PO1: Disciplinary Knowledge:**

CO3: In a specialization domain of his/her choice, student manager will be able to choose an appropriate topic for study and will be able to clearly formulate & state a research problem.

CO4: For a selected research topic, student manager will be able to compile the relevant literature and frame hypotheses for research as applicable.

CO5: For a selected research topic, student manager will be able to plan a research design including the sampling, observational, statistical and operational designs if any.

CO6: For a selected research topic, student manager will be able to compile relevant data, interpret & analyze it and test the hypotheses wherever applicable.

CO7: Based on the analysis and interpretation of the data collected, student manager will be able to arrive at logical conclusions and propose suitable recommendations on the research problem.

CO8: Student manager will be able to create a logically coherent project report and will be able to defend his/her work in front of a panel of examiners.

PO2: Critical Thinking and Problem solving:

CO4-CO8: All these points involve critical thinking and problem-solving skills, especially in the context of conducting research and analyzing data.

PO4: Research-related skills and Scientific temper:

CO3-CO8: These points explicitly relate to research-related skills, including choosing a research topic, compiling literature, designing research, collecting and analyzing data, and arriving at logical conclusions.

PO6: Personal and Professional Competence:

CO1-CO8: All the points contribute to the development of personal and professional competence, especially in the context of managing research projects and defending work.

PO8: Environment and Sustainability:

CO1-CO2: These points relate to environmental problem-solving and awareness of innovative methodology in the context of environmental issues.

PO9: Self directed and lifelong learning:

CO1-CO8: These points involve self-directed learning, especially in the context of research methodology and project management.
