

Veer Narmad South Gujarat University, SURAT.
B.Sc. Environmental Science-Syllabus (CBCS)

Semester VI
CORE - I
PAPER – I

Env 601: ENVIRONMENTAL SCIENCE – XVII
ENVIRONMENTAL GEOLOGY

OBJECTIVES: The paper intends to deal with the basic components and principles of physical environmental geology along with the interactions between geologic processes, ecological processes and society.

Total Hours: 30

UNIT 1	Plate tectonics	09
1.1	Structure of earth	
1.2	History of tectonics	
1.3	Theory of tectonics	
1.4	Seafloor spreading	
1.5	Pangaea and present continents	
UNIT 2	Natural hazards	09
2.1	Introduction	
2.2	Earthquakes	
2.3	Volcanoes	
2.4	Tsunami	
2.5	Rivers and flooding	
UNIT 3	Mining and environment	06
3.1	Introduction	
3.2	Effects of mining on environment	
3.3	Impact of mining in society	
3.4	Environmental impact of coal industry	
3.5	Reclamation	
UNIT 4	Petroleum Geology	06
4.1	History of petroleum exploration	
4.2	Physical & chemical properties of petroleum	
4.3	Well drilling	
4.4	Geophysical methods of exploration	
4.5	Non-conventional petroleum resources – Oil Shale, Tar sand, Shale gas, Hydrocarbon (Plastic/Solid)	

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Books:

1. Geochemistry and Environmental Geology - R. V.,Sagar 1st Edition, 2014, Anmol Publications Pvt. Ltd.
2. Physical Geography and the Environment - J.Holden , 3rd Edition, 2012 Pearson Publishers.
3. Introduction to Environmental Geology - E. A.Keller, 5th Edition, 2012, Pearson Publishers.
4. General Geology - Kailash R., 1st Edition, 2014, Anmol Publications Pvt. Ltd.
5. Elements of Petroleum Geology – Selley R. C., 2nd Edition, 1998, Academic Press.

PRACTICAL – XVII

1. To indicate presence of unsaturated hydrocarbons in environmental samples.
2. To indicate presence of saturated hydrocarbons in environmental samples.
3. Sampling plan for geological samples.
4. To study Topographic Maps.

Semester VI
CORE - I
PAPER – II

Env 602 : ENVIRONMENTAL SCIENCE – XVIII
INSTRUMENTATION TECHNIQUES IN ENVIRONMENTAL ANALYSIS

OBJECTIVES: The paper intends to deal with various instrumental techniques i.e. electro-analysis, spectroscopy and chromatography analysis required in different area of environmental monitoring.

		Total Hours: 30
UNIT 1	Electrometric analysis	06
1.1	Principle, Instrumental set up and Applications	
1.1.1	pH meter	
1.1.2	Ion Selective Electrodes	
1.1.3	Conductivity meter	
UNIT 2	Spectroscopy	09
2.1	Introduction: EMR regions, energy changes	
2.2	Principle, Instrumental set up and Applications	
2.2.1	Flame Photometer	
2.2.2	Colorimeter	
2.2.3	Spectrophotometer	
2.2.4	Atomic Absorption Spectrophotometer	
UNIT 3	Gas Chromatography	09
3.1	Principle, Instrumental set up and Applications	
3.1.1	Gas Solid Chromatography	
3.1.2	Gas Liquid Chromatography	
3.2	Factors affecting GC separation	
UNIT 4	Liquid Chromatography	06
4.1	Principle, Instrumental set up and Applications	
4.1.1	High Performance Liquid Chromatography	
4.1.2	Ion Exchange Chromatography	

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Books:

1. Principles of Instrumental Analysis , D.A. Skoog, F.J. Holler, and S.R. Crouche, 11th Edition, 2012, Cengage Learning
2. Instrumental Methods of Analysis, H.H. Willard, L.L. Meritt and J.A. Dean, 7th Edition 1st Edition, 1986, CBS Publishers
3. Analytical Instrumentation, G. Currell, 1st Edition, 2002, (1st Reprint, 2010) , Wiley India
4. Handbook of Analytical Instruments, R.S. Khandpur, 2nd Edition, 2006, (3rd Reprint, 2008) Tata Mc Graw Hill publications
5. Instrumental Methods of Analysis, B.K. Sharma, 24th Edition, 2005, Krishna Prakashan.
6. Instrumental Methods of Chemical Analysis, H. Kaur, 8th Edition, 2012, Pragati Prakashan
7. Environmental Chemistry, H. Kaur, 9th Edition, 2015, Pragati Prakashan

PRACTICAL – XVIII

1. To determine divalent metal ion (Fe^{+2}) of water sample.
2. To determine trivalent metal ion (Al^{+3}) of water sample.
3. To determine hexavalent metal ion (Cr^{+6}) of water sample.
4. To determine monovalent anion (NO_2^{-1}) of water sample.
5. To determine divalent anion (SO_4^{-2}) of water sample.
6. To determine trivalent anion (PO_4^{-3}) of water sample.

Semester VI
CORE - I
PAPER – III

Env 603 : ENVIRONMENTAL SCIENCE – XIX
GREEN CHEMISTRY

OBJECTIVES: The paper intends to deal with Green chemistry & use of this chemistry for pollution prevention by environmentally conscious design of chemical products and processes.

		Total Hours: 30
UNIT 1	Green Chemistry-I	06
1.1	Green chemistry : Definition & Introduction	
1.2	Need for green chemistry	
1.3	Sustainability and cleaner product	
1.4	Green chemistry & Eco-efficiency	
1.5	Principles of Green chemistry	
1.6	Examples of green chemistry	
1.6.1	Supra molecular chemistry	
1.6.2	Natural Product synthesis	
1.6.3	Laboratory chemicals	
1.6.4	Organometallic chemicals	
1.6.5	The future of green chemistry	
UNIT 2	Green Chemistry-II	09
2.1.	Concept of Atom Economy	
2.2	Atom Economy in a Substitution Reaction, Elimination Reaction, Addition Reaction, Rearrangement Reaction	
2.3	The concept of Atom Economy in chemical synthesis.	
2.4.	Tools green chemistry	
2.4.1	Green starting materials & Reaction Media.	
2.4.2	Green catalysts	
2.4.3	Green reactions	
2.4.4	Green Reaction conditions	
2.4.5	Green chemical products	
2.4.6	Use of Renewable feed stock.	
UNIT 3	Waste Management and application of Green Technology	06
3.1	Sources and types of waste.	
3.2	Waste treatment and disposal: Integrated waste Management & supercritical oxidation of waste.	
3.3	Integrated waste management of plastics: Illustration of 4R's	

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UNIT 4 Microwave Technology-A step towards green chemistry	06
4.1 Theory of microwave heating	
4.2 Reaction vessel choice	
4.3 Techniques in MORE chemistry	
4.4 Applications of dry media synthesis	
4.5 Applications of solvent mediated reactions	
4.6 Applications of PTC in MORE chemistry.	
4.7 Laboratory applications & other important application of MORE chemistry	
4.8 Industrial Manufacture of fine chemicals & advantage of MORE chemistry.	

Books:

1. Green Chemistry: Environmentally Benign Reactions- Editor: V. K. Ahluwalia , 1st Edition 2009, New Delhi Ane books
2. Chemistry of green environment- M. M.Srivastava and R. Sanghai, 1st Edition, 2011, Narosa publishing house, New Delhi
3. Introductory green chemistry- J. N. Gurtu and A. Gurtu, 1st Edition, 2012, Pragati Prakashan, India.
4. Green Chemistry: Environment friendly alternatives - R. Sanghai and M. M. Srivastava, 1st Edition, 2012, Narosa publishing house, New Delhi
5. Environment chemistry with Green chemistry - A. Das, 1st Edition, 2012, Books and Allied pvt. ltd.

PRACTICALS – XIX

1. Determination of amount of ascorbic acid in a vitamin C tablet by redox titration
2. Separation of food dyes by paper chromatography
3. Determining the percent of water in epsom salt
4. Organic preparations
 - (a) Preparation of Acetanilide from Aniline
 - (b) Synthesis of Adipic acid from cyclohexene
5. Green procedure for organic qualitative analysis. Detection of N,S, Cl, Br

Semester VI
CORE - I
PAPER – IV

Env 604 : ENVIRONMENTAL SCIENCE -XX
INDUSTRIAL WASTEWATER ANALYSIS AND TREATMENT

OBJECTIVES:

The paper intends to deal with industrial wastewater analysis: physical and chemical characteristics; sources and characteristics of wastewater of some industries; treatment methods and working of CETP.

Total Hours: 30

UNIT 1	Industrial Wastewater and its analysis	08
1.1	Collection and Preservation of wastewater	
1.2	Analysis of wastewater:	
1.2.1	Physical characteristics: Color, Odor, Temperature, Turbidity, Specific Conductivity, Total solids	
1.2.2	Chemical characteristics: pH, Oil and grease, Hardness, Chlorides, Sulphates, Phosphate, Nitrite, Nitrate, Ammoniacal nitrogen, Heavy metals, DO, COD, BOD, TOC	
UNIT 2	Sources and Characteristics of Waste water of different industries	10
2.1	Sources of waste water from industries: Sugar, Textiles, Distillery, Fertilizers, Dairy, Pharmaceuticals	
2.2	Characteristics of waste water from industries: Sugar, Textiles, Distillery, Fertilizers, Dairy, Pharmaceuticals	
2.3	Indian standards related to disposal of treated effluents	
UNIT 3	Treatment of industrial waste water	10
3.1	Physical methods: Screening, Sedimentation and Flootation, Equalization, Proportioning, Adsorption, Gas transfer	
3.2	Chemical methods: Neutralization, Coagulation, Precipitation, Oxidation and Reduction, Electrolysis, Ion exchange	
3.3	Biological methods:	
3.3.1	Aerobic processes: Lagooning, Trickling filter, Activated sludge	
3.3.2	Anaerobic processes: Anaerobic Digestion process, Up flow anaerobic sludge bed reactor process	

Semester VI
CORE - I
PAPER - V

Env 605: ENVIRONMENTAL SCIENCE – XXI
ENVIRONMENTAL BIOTECHNOLOGY

***OBJECTIVES:** Environmental Biotechnology is the study of applications of living organisms to improve environment health. These improvement methods often include treatment, degradation and removal of contaminated waste and remediation of soils. Due to its applications, study of environmental biotechnology is essential in today's industrial era.*

Total Hours: 30

UNIT 1 Introduction and methods in environmental biotechnology **07**

- 1.1 Introduction and scope of environmental biotechnology
- 1.2 Role of environmental biotechnology in management of environmental problems
- 1.3 Detection of environmental pollution: Cell biological, molecular biological and biosensor based methods
- 1.5 Abatement of CO₂ pollution using algal biomass
- 1.6 Bioquenching of toxic metals

UNIT 2 Bioremediation and Phytoremediation **09**

- 2.1 Introduction, constraints and priorities of Bioremediation
- 2.2 Types of bioremediation
- 2.3 Solid and liquid phase bioremediation
- 2.4 Introduction and types of phytoremediation
- 2.5 Factors influencing Phytoremediation
- 2.6 Success story of bioremediation in India - Oilzapper developed by TERI, New Delhi

UNIT 3 Role of genetic engineering in Environmental Biotechnology **07**

- 3.1 Basic techniques in genetic engineering
- 3.2 Introduction to plasmid and phage vector systems
- 3.3 Applications of genetic engineering in bioremediation
- 3.4 Genetically Engineered Microbes (GEMs) in Bio treatment of xenobiotics

UNIT 4 Emerging Environmental Biotechnologies **07**

- 4.1 Biodegradation - Microbial basis of biodegradation
- 4.2 Biodegradation of herbicides and pesticides
- 4.3 Bioleaching
- 4.4 Microbial fuel cell
- 4.5 Biodegradable plastic
- 4.6 Environmental Nanotechnology and applications

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Books:

1. Environmental Biotechnology: Basic concepts and applications - I. S. Thakur, 1st Edition, 2006, IK International Publications, New Delhi
2. Environmental Biotechnology - M. H. Fulekar, 1st Edition, 2010, Science Publishers, CRC press, Taylor & Francis, USA
3. Introduction to Environmental Biotechnology - A. K. Chaterjee, 3rd Edition, 2011, PHI Publications, New Delhi, India
4. Environmental Biotechnology: Principles and Applications - B. Rittman and P. L. McCarty, 2nd Edition, 2001, Tata McGraw-Hill publications, New Delhi
5. Environmental Biotechnology - A. Scragg, 2nd Edition, 2005, Oxford University Press Inc., New York, USA
6. Principles of gene manipulation and genomics - S. B. Primrose and R. Twyman, 7th Edition, 2009, Blackwell Publishing, USA
7. Genetic Engineering: Principles and practice - S. Mitra, 2nd Edition, 2015, McGraw Hill Education (India) Private Limited, New Delhi

PRACTICALS - XXI

1. Isolation of plasmid DNA by miniprep method.
2. Study of heavy metal biosorption by using fungal biomass.
3. Isolation of xenobiotic (Phenol) degrading bacteria by selective enrichment technique.
4. Isolation of hydrocarbon (Diesel) degrading bacteria by selective enrichment technique.

Semester VI
CORE - I
PAPER – VI

Env 606 : ENVIRONMENTAL SCIENCE – XXII
ECOINFORMATICS

OBJECTIVES: *The paper intends to deal with the approaches of information technology in environment science.*

		Total Hours: 30
UNIT 1	Ecoinformatics: An Introduction to Ecological Data & Information	08
	1.1 Introduction to information and informatics, bioinformatics	
	1.2 Online resources for managing ecological data and information	
	1.3 Ecoinformatics centre	
	1.4 Database and its types	
	1.5 Information Retrieval from Biological Databases	
UNIT 2	Ecological analysis	07
	2.1 Analysis tools and products	
	2.2 Geostrategies (GBR)	
	2.3 Geospatial infrastructure database (ASPRS, TERRA)	
UNIT 3	Ecological knowledge system	08
	3.1 Introduction to concept mapper: SEEK, VEGBANK	
	3.2 SEEK software	
	3.3 Analysis and modeling	
UNIT 4	Ecosystem visualization and taxonomic hierarchies	07
	4.1 Introduction to Spire, ELVIS	
	4.2 ELVIS tools	
	4.2.1 Species list constructor	
	4.2.2 Food Web constructor	
	4.2.3 Evidence Provider	
	4.3 Ontology Tool (SPOTTER)	

Books:

1. Essential Bioinformatics - J. Xiong, 2nd Edition, 2009, Cambridge University Press, New York, USA.
2. Bioinformatics - M. M. Ranga, 2nd Edition, 2008, Agrobios.
3. Bioinformatics: A Biologist's guide to Biocomputing and Internet - M. S. Brown, 1st Edition, 2000, Eaton Publishing, Natick, USA.
4. Ecoinformatics: Tools and Techniques - R. A. Reddy, 1st Edition, 2009, SBS Publishers, New Delhi.

PRACTICAL - XXII

1. Plant data retrieval from Veg Bank database.
2. Algae data retrieval from Algal base database.
3. Study of food web from PEaCE Lab database tool.(foodwebs.org/)
4. IUCN data retrieval from IUCN red list database.
5. IUCN data retrieval from image database WDPA dataset.

Semester VI

**IDS: ENVIRONMENTAL SCIENCE
ENTREPRENEURSHIP AND ECOTOURISM**

OBJECTIVES: The paper intends to deal with the approaches of entrepreneurship in environment science.

Total Hours: 30

UNIT 1	Entrepreneurship: An Introductory	08
1.1	Introduction Entrepreneurship	
1.2	Concept of Entrepreneurship, Entrepreneurship in India, Case Studies	
1.3	Theories of Entrepreneurship	
1.4	Nature and importance of Entrepreneurship	
UNIT 2	Ecotourism	07
2.1	Introduction of Ecotourism	
2.2	Sustainability's Components Economic Footprint	
2.3	Basics of Ecotourism	
2.4	Key strategies for development of ecotourism	
UNIT 3	Tourism and Natural Resource Management	08
3.1	Recent and future Trends in Tourism	
3.2	Economic benefits and impacts of tourism	
3.3	Economic Values, Revenues and Management Systems	
3.4	Systems for estimating Local Economic impacts	
UNIT 4	Legal and Tax issues for Entrepreneurship	07
4.1	Legal and tax considerations	
4.2	Tax Issues	
4.3	Stages of Entrepreneurial Financing	
4.4	Types of Entrepreneurial Financing	
4.5	Business opportunities in India	

Books:

1. The dynamics of entrepreneurial development and management - V. Desai, 7th Edition, 2011, Himalaya Publishing House, New Delhi.
2. Entrepreneurship- N. Johri, 1st Edition, 2014, Random Publications, New Delhi, India.
3. An introduction to ecotourism - A. Chauhan, 1st Edition, 2014, Anmol Publications Pvt. Ltd., New Delhi, India.
4. Fundamentals of ecotourism - A. Shrivastava, 1st Edition, 2014, Anmol Publications Pvt. Ltd., New Delhi, India.