VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. SEMESTER-III

ENVIRONMENTAL CHEMISTRY

SYLLABUS TO BE EFFECTIVE FROM JUNE 2019

PAPER- I (FUNDAMENTALS OF ENVIRONMENT AND ECOLOGY)

Max. Marks: 70 Total Periods: 45

UNIT-1 ENVIRONMENTAL SCIENCE: (12 Periods)

- Environmental Science: An Interdisciplinary Science
  Fundamentals, Definition, principles, scope and importance
- Environmental components:
  - Atmosphere
  - Lithosphere
  - Hydrosphere
  - Biosphere

Global Environmental Problems, Man and Environment

UNIT-2 NATURAL RESOURCES: (11 Periods)

Natural Resources: Renewable and non renewable sources:
Natural resources and associated problems

- Forest resources
- Water Resources
- Mineral resources
- Land Resources
- Energy Resources- Energy flow, Fossil Fuels, Geothermal energy, Nuclear, Wind, Solar and Biomass energy , Hydro power, Ocean Thermal Energy Conversion, Tidal power,
- Food Resources -Agriculture-fertilizer and the green revolution, Environmental degradation, Nutrition- energy and calories, protein, minerals and vitamins,antioxidants.

UNIT-3 ECOSYSTEMS (11 Periods)

- Concepts of an ecosystem
- Structure and function of an ecosystem
- Producers, Consumer and decomposers
- Ecological succession
- Food chains, Food webs and ecological pyramid,
- Types, Characteristic features, structure and function of the ecosystems:
  Forest ecosystem, Grassland ecosystem , Dessert ecosystem

UNIT-4 NATURAL HAZARDS: (11 Periods)

- **River flooding:** Causes, Nature and frequency of flooding, Nature and extent of flood hazard, urbanization and flooding, Environmental effects of flooding, Flood mitigation methods
- **Landslides:** Causes, human use and landslides, Prevention and correction
- **Costal Hazards:** Tropical cyclone and tsunamis, Costal erosion, Sea level changes and its impacts on costal areas
- **Earthquakes:** Causes, Intensity and magnitude of earthquakes, Nature of destruction, Ground Subsidence, Protection from earthquake hazards.
- **Volcanism:** Nature, extent and causes of volcanism, Volcanism and climate

Reference Books:

1. Environmental Chemistry by Dr. A. K. De
2. Environmental Chemistry, Goel Publishing house meerut, by B. K. Sharma and H. Kaur.
3. Basic Concept of environmental Chemistry by Des. W. Connell.
4. Chemistry for environmental engineering and science, 5th Ed., by sawyer, McCarty and Parkin.
5. Environmental Chemistry, 7th Ed., By S. E. Manahan.
6. Chemistry for environmental Engineering 4th Ed., By sawyer, McCarty and Parkin.
7. Instant note in ecology by Mackenzie, Ball and virdee.
8. Marin biology: An Ecological approach, 2nd Ed., By James W. Nybakken.
9. Chemistry of Environment, 2nd Ed., By Thomas G. Spiro and William M. Stigliani.

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M.Sc. SEMESTER-III

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PAPER- (II) ENVIRONMENTAL POLLUTION

Max. Marks: 70 Total Periods: 45

UNIT-1 AIR POLLUTION (12 Periods)

- Definition, Chemical composition and Air quality, Classification and Properties of air pollutants, Sources of air pollutants,
- Ozone Chemistry formation and destruction, Ultraviolet Protection by Ozone, Catalytic Destruction of Ozone hydroxyl radical, chlorine and bromine, nitric oxide, Polar Ozone Destruction, Ozone Projections,
- Climate- Radiation balance, Albedo- particles and clouds, Greenhouse Effect-IR absorption and molecular vibrations, greenhouse gas trends.
- Global Warming, Acid Rain, Vehicular pollution, Photochemical smog, Radiation, Effects of Air pollution on health, Vegetation and Materials.

UNIT-2 WATER POLLUTION : (11 Periods)

- Characteristics of bodies of water, Aquatic life- Eutrophication, Water pollution- Definition, Sources, Categories, Nature and Types and sources of water Pollution, Types of Water Pollutants -Inorganic pollutants, Elemental Pollutants, Heavy Metals, Metalloids, Organically Bound Metals and Metalloids, Inorganic Species, Organic Pollutants: Pesticides in Water, Polychlorinated Biphenyls, Radionuclides in the Aquatic Environment,
- Effect of oil pollution in marine water
- Adverse effects of water pollution.

UNIT-3 SOIL POLLUTION: (11 Periods)

- Nature and Composition of soil
- Characterization of Soil
- Soil Contaminants- Sources and Chemical Nature
- Important environmental Properties of Soil Contaminants ,
- Ecological and Health effects of soil Contaminants

UNIT-4 NOISE, RADIATION AND THERMAL POLLUTION: (11 Periods)

(A) Noise Pollution-Basic Properties of sound waves-Plane and spherical waves, Sound Pressure and intensity levels, Decibel, Effects of meteorological parameters on sound propagation, Measurement and analysis of sound. A weighted sound level, Noise pollution level, Sound exposure level, Traffic noise index, Day-Night level, Noise criteria curves, Noise sources, Noise control and abatement measures.

(B) Radiation Pollution- Introduction: Definition, Sources, Nuclear concepts and terminology and ecological importance, Maximum Permissible limit, Effects of radiation- Acute, Chronic and Genetic.

(C) Thermal Pollution- Introduction-Definition, Sources of thermal pollution, Biological and other effects of thermal pollution, hazardous effects, Thermal Stratification, Management of waste heat.

Reference:

1. Basic Concept of environmental Chemistry by Des. W. Connell.
2. Environmental Chemistry, 7th Ed., By S. E. Manahan.
3. Environmental Chemistry by Dr. A. K. De

VEER NARMAD SOUTH GUJARAT UNIVERSITY

M.Sc. SEMESTER-III

ENVIRONMENTAL CHEMISTRY

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PAPER- III (WASTE, WASTE MANAGEMENT AND TOXICOLOGY)

Max. Marks: 70 Total Periods: 45

Unit-1 SOLID AND HAZARDOUS WASTE (12 Periods)

(A) Sources of solid waste
(Domestic, Industrial, Municipal, Hospital, Nuclear, Agriculture),

- Characteristic of Solid waste- Physical, Chemical and Biological Properties
- Processing - Physical, Chemical and Biological treatment of solid waste
- Recycling of waste
- Disposal of solid waste Methods, Site selection of disposals Solid waste management and handling rules.

(B) Classification and sources of Hazardous Wastes -Flammable and Combustible Reactive and Corrosive Substances, Physical Forms and Segregation of Wastes, Hazard Ranking System, Physical and Chemical Properties of Hazardous Wastes, Transport, Effects, and Fates of Hazardous Wastes

Unit-2 (11 Periods)

(A) Radioactive Waste

Nuclear or Radioactive Waste- Principles of radioactivity, Sources of radioactivity in environment, Characteristics of nuclear waste, Radioactive materials and its decay, Half-life, Health effects of ionizing Radiation, Safety standards.

(B) Disposal and Analysis of radioactive waste

Detection and Analysis of radioactive materials, Mining and Recovery, Low-level Radioactive waste, High-level radioactive waste, transport of Radioactive Materials, Storage and Disposal of radio active waste, New waste reduction technologies

Unit-3 (11 Periods)

(A) Biomedical and e-waste

Introduction, characterization of biomedical waste, handling and disposal of biomedical waste, medical waste treatment techniques, Biomedical waste: Environment standards and guidelines for management, Management and disposal of electronics waste, Basel convention.

(B) Waste treatment Technologies

Waste destruction technologies, waste concentration technologies, TSDF cradle to grave concepts, solidification and stabilization technologies, biological treatment, biotreatment by sequencing batch reactors, thermal

processes,storage and leak detection- underground storage tanks, leak detection and remediation.

Unit-4 TOXICITY (11 Periods)

(A) Chemical Toxicology- Introduction, Principles of toxicology, Types of Toxic pollutants, TLV (Threshold limiting Value), Common toxic effects, Dosage-potency **VS** Toxicity, Lethal dosage (LD),Toxic chemicals in the environment, Biochemical Effects of Metals and gases(Pb, Cd, Hg, As, Cr, CO, NO_x and SO_2, Cyanide, Pesticides, Carcinogens, Bio-Warfare Agents,

(B) Genotoxicity- Teratogens and Teratogenesis,Teratogens (Alcohol, Methyl mercury, Rubella, Thalidomide), Mutagens and Mutagenesis, Carcinogens.

Reference books

1. Environmental Chemistry, 7^{th} Ed., By S. E. Manahan.
2. Chemistry for environmental Engineering 4^{th} Ed., By sawyer, McCarty and Parkin.
3. The Chemistry of Industrial Toxicology; By Hervey B. Elkins, John Wiley & Sons, New York. (2^{nd} Edit.)

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc. SEMESTER-III
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PAPER-IV (ENVIRONMENTAL STUDIES- INSTRUMENTAL TECHNIQUES)

Max. Marks: 70 Total Periods: 45

UNIT-1 NMR SPECTROSCOPY: (12 Periods)

Theory and principles of NMR spectroscopy, Theory of Fourier Transform.

(i) $_1$H-NMR Spectroscopy:

Proton resonance condition, Aspects of PMR spectra – number of signals, Chemical shifts, Shielding and deshielding, Diamagnetic anisotropy, Factors affecting chemical shifts, peak area and integration, splitting of the signals spin-spin coupling, coupling constants – vicinal, geminal, long range and virtual couplings, chemical shift equivalence and magnetic equivalence, proton exchange, deuterium exchange.

(ii) $_{13}$C-NMR Spectroscopy: Difficulties and solution for recording 13C-NMR spectra, recording of 13C-NMR spectra – scale, solvents, solvent signals and their positions, multiplicity, 13C-1H coupling constant – proton coupled and decoupled 13C spectra, broad band decoupling, off resonance technique. Chemical shifts in 13C spectra – chemical shift calculation for alkanes, alkenes and alkynes.

UNIT-2 INSTRUMENTAL TECHNIQUES FOR AIR AND WATER ANALYSIS: (11 Periods)

(A) Spectroscopic Technique for Water Analysis - U.V. – Visible Spectroscopy, FT-IR, Mass Spectroscopy, Flame Photometry, X-ray Fluorescence, ICP-OES, Chemiluminescence methods.

(B) Atomic Absorption and Atomic Fluorescence Spectrometry

Sample Atomization and Atomic Absorption Instrumentation, Interference AAS, Atomic Fluorescence Spectroscopy. Applications

(C)Atomic Emission Spectrometry- Emission Spectroscopy base on plasma sources, Emission Spectroscopy Based Arc and Spark Sources

UNIT-3 CHROMATOGRAPHIC TECHNIQUES: (11 Periods)

(A) GC, HPLC, Headspace GC, GC-MS, LC-MS

Ion Exchange Chromatography- Resins used – Principle of exchange Factors affecting the exchange – Capacity of resin and its determination, Techniques – IEC with eluent suppressor columns – Applications.

(B)Capillary Electrophoresis

Types of electrophoresis, The basis of electrophoresis Separations, Capillary zone and gel electrophoresis, Application.

UNIT-4 (11 Periods)

(A) Supercritical Fluid Chromatography - Introduction, Supercritical Fluid Chromatography- Instrumentation and Operating Variables, Comparison of Supercritical to other types of Chromatography, Advantages, Applications of Supercritical Fluid Chromatography.

(B) Electrical Techniques

Coulometry, Anodic Stripping Voltammetry, Ion Selective Electrodes Principle and Applications.

Reference Books:

1. Instrumental Analysis by R. D. Braun, McGraw-Hill.
2. Modern Methods of Chemical Analysis (2nd ed.), Pecsok, Shields, Cairns & McWilliom, John Wiley & Sons.
3. Principles of Instrumental Analysis (5th ed.) by Skoog, Holler and Nieman (Saunders College Publishings).
4. High Performance Liquid Chromatography, Dr. P.D. Sethi.
5. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
6. Spectrometric identification of Organic compounds, R.M. Silverstein, G.C. Bassler and

7. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Weily.
8. Application of Spectroscopy of Organic compounds, J.R. Dyer, Prentice Hall.
9. Spectroscopy Methods in Organic Chemistry, D.H. Williams, I. Fleming,Tata McGraw-Hill.
10. Spectroscopy of Organic compounds, P.S. Kalsi, New Age International Ltd.
11. Environmental Chemistry, De A.K.
12. Spectroscopy by Jagmohan
13. Analytical Chemistry by Gary D. Christian, Sixth Edition, Wiley Sons.
14. D. A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Analytical Chemistry – An Introduction, 7th ed(2000), S. C. Publishing, Philadelphia, London.

VEER NARMAD SOUTH GUJARAT UNIVERSITY
M.Sc. SEMESTER-III

ENVIRONMENTAL CHEMISTRY

PRACTICAL SYLLABUS TO BE EFFECTIVE FROM JUNE 2019

1	Major Exercise	4- Credit
2	Viva-Voce	
3	Minor Exercise	4- Credit
4	Minor Exercise	

Major Experiments

1. Removal of hazardous dyes/metals by Cloud Point Extraction using non-ionic surfactant.[TX-100]
2. Determination of the Chemical Oxygen Demand (COD) value of KHP sample using conventional method.
3. Determination of the Dissolved Oxygen (DO) in given water sample.
4. Analysis of water sample.
5. Determination of Ksp of AgI and AgCl and find out amount of KCl and Ki in a given (KI + KCl) using potentiometric titration.
6. Determination of total salt content by ion exchange chromatography.
7. Determination of pKIn of Methyl red indicator.
8. Determination of pKIn of Bromo Phenol Blue Indicator.
9. Ion-Exchange separation of Fe^{+3} and Co^{+2} and determination Fe^{+3} by Spectrophotometer.

Minor Experiments

10. Precipitation Titration: Determination of Chloride by the Mohr's Method.
11. Determination of Aniline.
12. Determination of % purity of Aspirin in given tablet.
13. Determination of sulphate using complexometric titration.
14. Determination of the Rf value of amino acids in a given mixture by the technique of ascending out descending Paper chromatography.
15. Spectroscopic determination of Ni^{+2} with D.M.G.
16. Conductometric determination of vanillin in Vanilla.
17. Analysis of Insecticides: Analysis of BHC.
18. Colorimetric estimation of titanium in the given solution by hydrogen peroxide.
19. Estimation of amino acids by colorimetry.
20. Electro gravimetric determination of Cu^{+2} in given unknown/Brass solution.
21. Determination of the amount of As_2O_3 in the given solution by coulometric titration.
22. Determination of the amount of PO_4^{-3} in given sample of soil by spectrophotometrically.
23. Determination of the Iodine value of given fat sample.
24. Determination of saponification value of given oil fat sample.

Note:

- Practical examination will be for **2 days in each semester.**
- **6** hours duration on each day.

Recommended books:

1. Quantitative Inorganic Analysis including Elementary Instrumnetal analysis, By A. I. Vogel, 3ed, ELBS, 1964.
2. Vogel's Quantitative Chemical Analysis; J. Mendham, R. C. Denney, J. D. Barnes, M. Thomas, B. Sivasankar; Pearson Publication.
3. Analytical Chemistry; Gary D. Christian; Willey India Pvt. Ltd.
4. Evironmental Pollution, A.K. De
5. Evironmental Pollution, B.K. Sharma & H.Kaur
6. Quantitative Analysis by R.A. Day and A. L. Underwood, (Sixth Edition)
7. Standard methods of chemical analysis, Sixth Edition, F.J. Welcher.
8. Standard Methods of Chemical Analysis: Vol. I & II (6th edition), D. Van Nostrand Co. Inc. (London).
9. Official Methods of Analysis: Published by Association of Official Analytical Chemists, Washington.
10. Advance practical physical chemistry by J. B. Yadav
11. Advanced University Practical chemistry by P.C. Kamboj (Part-1)
12. Advance Practical Chemistry by R. Mukhopadhyay and P. Chatterjee
13. Official Methods of Analysis: Published by Association of Official Analytical Chemists, Washington.
14. APHA Standard methods 21st Edition.