Re-Accredited 'B++' 2.86 CGPA by NAAC
VEER NARMAD SOUTH GUJARAT UNIVERSITY
University Campus, Udhna-Magdalla Road, SURAT - 395 007, Gujarat, India.
વીર નર્મદ દક્ષિણ ગુજરાત યુનિવર્સિટી
યુનિવર્સિટી કેમ્પસ, ઉધના-મગદલ્લા રોડ, સુરત - ૩૯૫ ૦૦૭, ગુજરાત, ભારત.
Tel : +91 - 261 - 2227141 to 2227146, Toll Free : 1800 2333 011, Fax : +91 - 261 - 2227312
E-mail : info@vnsgu.ac.in, Website : www.vnsgu.ac.in

-: પરિપત્ર :-

વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન અનુસ્નાતક અભ્યાસક્રમ ચલાવતી તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા વિભાગીય વડાશ્રીને જણાવવાનું કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪થી અમલમાં આવનાર M.Sc. Sem.-3 Environmental Chemistry ના સુધારેલ અભ્યાસક્રમ સંદર્ભે રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિની તા.૦૪/૧૨/૨૦૨૩ ની સભાના ઠરાવ ક્રમાંક :૦૬ અન્વયે નીચે મુજબ કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ એકેડેમિક કાઉન્સિલની તા.૦૬/૧૨/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૪૭ થી મંજૂર કરેલ છે. જેનો અમલ કરવા આથી જાણ કરવામાં આવે છે.

રસાયણશાસ્ત્ર વિષયનીઅભ્યાસ સમિતિની તા.૦૪/૧૨/૨૦૨૩ ની સભાનાં ઠરાવ ક્રમાંકઃ૦૬

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪ થી અમલમાં આવનાર M.Sc.Chemistry Sem.-3 નો Environmental Chemistry નો સુધારેલ અભ્યાસક્રમ સર્વાનુમતે મંજૂર કરી વિજ્ઞાન વિદ્યાશાખાને ભલામણ કરવામાં આવે છે.

એકેડેમિક કાઉન્સિલની તા.૦૬/૧૨/૨૦૨૩ની સભાનાં ઠરાવ ક્રમાંકઃ ૪૭

:: આથી ઠરાવવામાં આવે છે કે, શૈક્ષણિક વર્ષ ૨૦૨૩–૨૪થી અમલમાં આવનાર M.Sc. Chemistry Sem.-3 નો સુધારેલ Environmental Chemistry ના અભ્યાસક્રમ સંદર્ભે રસાયણશાસ્ત્ર વિષયની અભ્યાસ સમિતિની તા.૦૪/૧૨/૨૦૨૩ ની સભાના ઠરાવ ક્રમાંક :૦૬ અન્વયે કરેલ ભલામણ વિજ્ઞાન વિદ્યાશાખાના અધ્યક્ષશ્રીએ વિદ્યાશાખાની મંજૂરીની અપેક્ષાએ વિદ્યાશાખાવતી મંજૂર કરી એકેડેમિક કાઉન્સિલને કરેલ ભલામણ સ્વીકારી મંજૂર કરવામાં આવે છે.

બિડાણઃ ઉપર મુજબ

ક્રમાંક : એસ./સાયન્સ/પરિપત્ર/૩૦૫૨૦/૨૦૨૩
તા.૦૭–૧૨–૨૦૨૩

કુલસચિવ

પ્રતિ,
૧) વિજ્ઞાન વિદ્યાશાખા હેઠળની સંલગ્ન તમામ કોલેજોનાં આચાર્યશ્રીઓ તથા વિભાગીય વડાશ્રી.
..... આપશ્રીની કોલેજ/વિભાગના સંબંધિત શિક્ષકોને જાણ કરી અમલ કરવા સારૂ.
૨) અધ્યક્ષશ્રી, વિજ્ઞાન વિદ્યાશાખા.
૩) પરીક્ષા નિયામકશ્રી, પરીક્ષા વિભાગ, વીર નર્મદ દ. ગુ. યુનિવર્સિટી, સુરત.
.....તરફ જાણ તેમજ અમલ સારૂ.

Veer Narmad South Gujarat University, Surat.

M. Sc. Chemistry Programme

Syllabus
M.Sc. Environmental Chemistry
Semester-III

To Be Effective From December-2023
NEP 2020

M. B. Mahida.

VEER NARMAD SOUTH GUJARAT UNIVERSITY

Name of Program	**Master of Science (Chemistry)**
Abbreviation	**M.Sc.**
Duration	**2 Years**
Eligibility Criteria	**Course- M.Sc. Environmental Chemistry** Eligibility: Graduation in Science with Chemistry or any subject equivalent to or allied to Chemistry.

M.Sc. Semester-III (ENVIRONMENTAL CHEMISTRY)

Theory Paper /Practical	Teaching schedule Hrs/week	Exam Schedule			Total marks	Credit
		Duration Hrs	Internal marks	External marks		
Theory papers:						
1) Core-1 (ECC-301) *Fundamentals of environment and ecology*	4	3	30	70	100	4
2) Core-2 (ECC-302) *Environmental pollution*	4	3	30	70	100	4
3) Core-3 (ECC-303) *Waste, Waste management and toxicology*	4	3	30	70	100	4
Inter/Multidisciplinary(AECC) 4) Elective Paper-1 (EEC-301) *Environmental studies and instrumental techniques* **Or** Elective Paper-2 (EEC-302) *Analysis of Fuel, Food and Water*	4	3	30	70	100	4
5) Skill Based Elective paper /Swayam/MOOC courses (OSEC-301) *Industrial Safety & Water Analysis Techniques*	2	2	15	35	50	2
6) Practical (EP-301)	12	12	60	140	200	6
Total	30	26	195	455	650	24

Evaluation Pattern		
No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	30%
2.	University Examination Practical Examination-2 days-6 h each day	70%

Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participatein seminars/ workshops, presentations by students, assignments etc.

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Master of Science, Chemistry
M.Sc. Environmental Chemistry, Semester-III
NEP-2020
SYLLABUS TO BE EFFECTIVE FROM DECEMBER-2023
Course Code- ECC-301
Paper-I: Fundamentals of Environment and Ecology

Total Credits of the Course	4	Hours per Week	4 hrs

Course Objectives:	• To understand the fundamentals of environmental principles, the scope of environmental science and to learn their importance through studying various components of environment which will helpful to be aware of Global environmental problems. • To study the natural resources and its associated problems, the renewable and non-renewable sources and to learn various resources of natural resources of ecosystem • To understand the concept, structure and function of ecosystem, the components of ecosystem that leads to grasp the knowledge of ecological succession and to understand the characteristic features and function of various type of ecosystem. • To learn the causes, effect, prevention, correction and protection ofvarious natural hazards.
Mapping between COs and PSOs	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	■	■	■	■	■	■			■	■		■
CO2	■	■		■	■	■			■	■	■	
CO3	■	■	■		■	■				■		■
CO4	■	■		■	■	■				■	■	■

Unit	Description	(4- Credit)
1.	**ENVIRONMENTAL SCIENCE**	(15 Periods)
	• Environmental Science: An Interdisciplinary Science Fundamentals, Definition, principles, scope and importance • Environmental Segments: ○ Atmosphere ○ Lithosphere ○ Hydrosphere ○ Biosphere • Global Environmental Problems, Man and Environment	

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	The natural cycles of the environment : Hydrological cycle, carbon cycle, oxygen cycle, nitrogen cycle, phosphorous cycles
2.	**NATURAL RESOURCE** (15 Periods) Natural Resources: Renewable and non-renewable sources: Natural resources and associated problems both • Forest resources • Water Resources • Mineral resources • Land Resources • Energy Resources - Energy flow, Fossil Fuels, Geothermal energy, Nuclear, Wind, Solar and Biomass energy, Hydropower, Ocean ThermalEnergy Conversion, Tidal power. • Food Resources - Agriculture-fertilizer and the green revolution, Environmental degradation, Nutrition energy and calories, protein, minerals and vitamins, antioxidants.
3.	**ECOSYSTEMS** (15 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, Dessertecosystem
4.	**NATURAL HAZARDS** (15 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 andcontrol/correction • **Coastal Hazards:** Tropical cyclone and tsunamis, Coastal erosion, Sea level changes and its impacts on coastal areas. • **Earthquakes:** Causes, Intensity and magnitude of earthquakes,Nature of destruction, Ground Subsidence, Protection from earthquake hazards. • **Volcanism:** Nature, extent and causes of volcanism, Volcanismand climate.

Course Outcome: Having Completed this course, the learner will be able to	
1.	Thoroughly understand the principles, fundamental, definition, scope and importance of environmental science, obtains the knowledge of various environmental components and learns the global environmental problem.
2.	Establish the knowledge of various natural resources like renewable and non-renewable sources, develops the grip of various natural resources and its associated problems.
3.	Gain an understanding of Ecosystem, its concept, structure, components and functions, which leads to understand the importance of ecological succession and learns the

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	characteristic features and function of different ecosystem.
4.	Know about the various Natural hazards such as river flooding, landslides, Coastal hazard, earthquake, volcanism and their causes, protection and prevention.

Suggested Reference Books:

1. Environmental Chemistry by Dr. A. K. De
2. Environmental Chemistry, Goel Pub. 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 andParkin.
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. Marine biology: An Ecological approach, 2nd Ed., By James W. Nybakken.
9. Chemistry of Environment, 2nd Ed., By Thomas G. Spiro and William M. Stigliani.

On-line resources to be used if available as reference material

Master of Science, Chemistry
M.Sc. Environmental Chemistry, Semester-III
NEP-2020
SYLLABUS TO BE EFFECTIVE FROM NOVEMBER-2023
Course Code- ECC-302
Paper-II: Environmental Pollution

Total Credits of the Course	**4**	**Hours per Week**	**4 hrs**

Course Objectives:	• To understand and familiarize with classification, properties, sources of air pollution and learn chemistry of ozone and climate. • To learn about various pollution-water & air and effluent treatment. Contamination of water through heavy minerals,halogens, pathogens, air pollution, detection of various components and hydrocarbons, effluent treatment of sugar, paper & pulp and distilleries. To understand basic concepts of air and soil, their properties and analysis of various pollutants and minerals present in soil by various methods. To understand the properties of sound waves, nuclear concepts and Thermal pollution.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12

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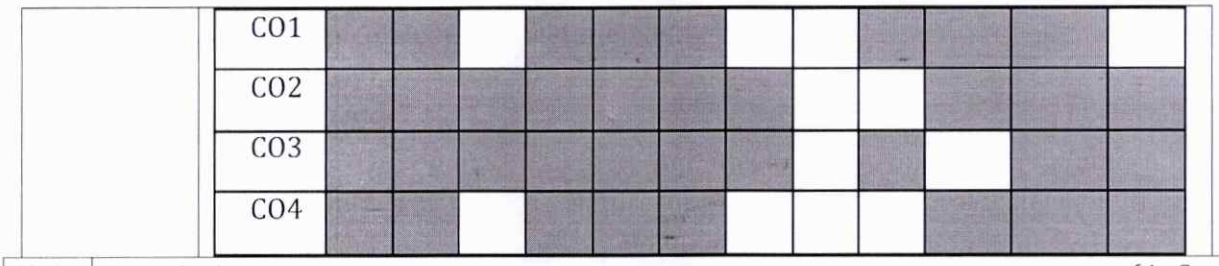

Unit	Description (4- Credit)
1.	**AIR POLLUTION** (15 Periods) • Definition, Chemical composition and Air quality, Classification and Properties of air pollutants, Sources of air pollutants. • Ozone Chemistry: formation and destruction, Ultraviolet Protection by Ozone, Catalytic Destruction of Ozone, hydroxyl radical, chlorine and nitric oxide, • Climate- Radiation balance, Greenhouse Effect-IR absorption and molecular vibrations. • Global Warming, Acid Rain, Vehicular pollution, Photochemical smog, Radiation, Effects of Air pollution on health, Vegetation and Materials • Carbon footprint.
2.	**WATER POLLUTION** (15 Periods) • Characteristics of bodies of water, Aquatic life- Eutrophication, Water pollution- Definition, Sources, Categories, Nature and Typesand sources of water Pollution, Types of Water Pollutants - Inorganic pollutants, Elemental Pollutants, Heavy Metals, Metalloids, Organically Bound Metals and Metalloids, Organic Pollutants: Pesticides in Water, Polychlorinated Biphenyls, Radionuclides in the Aquatic Environment, • Effect of oil pollution in marine water • Adverse effects of water pollution.
3.	**SOIL POLLUTION** (15 Periods) • Nature and Composition of soil and environmental chemistry of soil • Characterization of Soil, micronutrients in soil • Soil Contaminants- Sources and Chemical Nature • Important environmental Properties of Soil Contaminants • Ecological and Health effects of soil Contaminants • Effects of pesticides • Control of soil pollution as contaminants on soil
4.	**NOISE, RADIATION AND THERMAL POLLUTION** (15 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. Sound exposure level, Noise pollution 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, Nuclear Fuel cycle and Environment **(C)Thermal Pollution-** Introduction-Definition, Sources of thermal pollution, Biological

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	and other effects of thermal pollution, hazardous effects, Thermal Stratification, Management of waste heat, Prevention of Thermal Pollution

Course Outcome: Having Completed this course, the learner will be able to	
1.	To learn about air pollution and its adverse effects. Learn about ozone layer and Global Warming.
2.	Learn water & air pollution, basic concepts of Eutrophication, water contamination with heavy materials, halogens, hydrocarbons and water purifying techniques and purification of water, sewage treatment, determination of air pollutants SO_X, NO_X, CO_X and hydrocarbons. Development of technologies to compart gaseous pollutants, effluent treatment of various paper pulp & distillation.
3.	To understand the basic concept about soil and to derive the different characteristics and composition of soil. Understand fundamental & theory of the sources and available minerals in soils. Also learn the different approaches and classical as well as instrumental techniques used for the analysis.
4.	Understand the chemistry involved in noise, radiation and thermal pollution and their hazardous effects.

Suggested Reference Books:

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
4. A Textbook of Environment Chemistry and Pollution Control By S.S. Dara and Dr. D.D. Mishra

On-line resources to be used if available as reference material

Master of Science, Chemistry
M.Sc. Environmental Chemistry, Semester-III
NEP-2020
SYLLABUS TO BE EFFECTIVE FROM DECEMBER-2023
Course Code- ECC-303
Paper-III: Waste, Waste Management and Toxicology

Total Credits of the Course	**4**	**Hours per Week**	**4 hrs**

Course Objectives:	• To understand different types of hazardous waste and recycling it by different methods. Basic concepts of the physical and chemical properties of hazardous waste. • To learn about radioactive waste and new waste technologies for reduction of radioactive waste. Thorough study of properties of the nuclear waste.

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	• To understand what e-waste is and various wastewater treatments. • To understand the environmental guidelines and standards for management. • To study the different toxic effects of different metals and gases and to understand genotoxicity.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												

Unit	Description (4- Credit)
1.	**SOLID AND HAZARDOUS WASTE** (15 Periods) • **Sources of solid waste** (Domestic, Industrial, Municipal, Hospital, Nuclear,Agriculture), • Segragation of municipal solid waste • Characteristic of Solid waste- Physical, Chemical andBiological Properties • Processing - Physical, Chemical and Biological treatment ofsolid waste o Recycling of waste o Disposal of solid waste Methods, Site selection of disposals, Solid waste management and handling rules. • Introduction to hazardous waste and harmful effects, Sources and classification • Identification: Characteristics and types of listed hazardous waste • Generation, collection - storage, transfer and transport • Treatment Methods: physical, chemical, photolytic, thermal, biological, land treatment and composting • Ultimate disposal of waste: disposal above ground, surface impoundment, deep well disposal of liquids, secured landfill, In-situ treatment
2.	**Radioactive Waste: Disposal and Analysis** (15 Periods) • 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. • 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 radioactive waste, new waste reduction technologies.
3.	**Biomedical waste, e-waste and Waste treatment Technologies** (15 Periods) • **Biomedical and e-waste** Introduction, characterization of biomedical waste, handling and disposal of biomedical waste, medical waste treatment techniques, Biomedical waste:

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	Environment standards and guidelines for management, Management and disposal of electronics waste, Basel convention. • **Waste treatment Technologies** Waste destruction technologies, waste concentration technologies, TSDF, cradle to grave concepts, solidification and stabilization technologies, biological treatment, bio-treatment by sequencing batch reactors, thermal processes, storage and leak detection-underground storage tanks, leak detection and remediation.
4.	**TOXICITY** (15 Periods) • **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 theenvironment, Biochemical Effects of (Pb, Cd, Hg, As, Cr, Cyanide, Pesticides, Carcinogens, Bio-Warfare Agents) • **Genotoxicity:** Teratogens and Teratogenesis, Teratogens (Alcohol, Methylmercury, Rubella, Thalidomide), Mutagens and Mutagenesis,Carcinogens.

Course Outcome: Having Completed this course, the learner will be able to	
1.	Understand the source, classification, characteristics and disposal of hazardous waste.
2.	Learn radioactive waste and principle of radioactivity, its decay, health effects of ionization, to storage, transport and disposal of radioactive waste.
3.	Understand introductory part of biomedical waste and its disposal by different methods.
4.	Understand about chemical toxicity and genotoxicity in detail.

Suggested Reference Books:

1. Environmental Chemistry, 7th Ed., By S. E. Manahan.
2. Chemistry for environmental Engineering 4th Ed., By Sawyer, McCarty and Parkin.
3. The Chemistry of Industrial Toxicology; By Hervey B. Elkins, John Wiley & Sons, New York. (2nd Ed.)
4. Environmental Chemistry in Society, 3rd Ed, By James M. Beard and Ruth Ann Murphy
5. Management of Municipal Solid Waste, T.V. Ramchandra, 1st Ed., 2006, 5th reprint, 2014, Teri Press.

On-line resources to be used if available as reference material

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Master of Science, Chemistry
M.Sc. Environmental Chemistry, Semester-III
NEP-2020
SYLLABUS TO BE EFFECTIVE FROM DECEMBER-2023
Course Code- EEC-301
Paper-IV: Environmental Studies and Instrumental Techniques (Elective Paper-1)

Total Credits of the Course	**4**	**Hours per Week**	**4 hrs**

Course Objectives:	• To learn spectroscopic determination of compounds by ^{13}C NMR, ^{1}H NMR, and ^{2}D NMR and important concepts like chemical shift, coupling constants for different types of compounds. • To understand different types of spectroscopic techniques for water analysis. • To separate the various substances that make up a mixture. The applications range from a simple verification of the purity of a given compound to the quantitative determination of the components of a mixture. • To learn principles of different electrical techniques like coulometry, voltammetry etc. and Supercritical Fluid Chromatography.

Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	■	■	■	■	■				■	■		
CO2	■	■		■	■	■				■	■	■
CO3	■	■	■		■	■			■	■	■	
CO4	■	■			■	■				■	■	■

Unit	Description (4- Credit)
1.	**NMR SPECTROSCOPY** (15 Periods) • **^{1}H NMR Spectroscopy** Proton resonance condition, Aspects of PMR spectra – number of signals, chemical shift, factors influencing chemical shift, deshielding, chemical shift values and correlation for protons bonded to carbons (aliphatic, olefinic, aldehydic, aromatic) and other nuclei (alcohols, phenols, enols, acids, amides and mercaptans), effect of deuteration, spin- spin coupling, (n+1) rule,factors effecting coupling constant "J". • **^{13}C NMR spectroscopy** Types of ^{13}C NMR Spectra: proton coupled and decoupled ^{13}C spectra, chemical shift, calculations of chemical shifts of aliphatic, olefinic, alkyne, aromatic, hetero aromatic and carbonyl carbons, factors affecting chemical shifts.
2.	**SPECTROSCOPIC TECHNIQUES** (15 Periods) Principle, Instrumentation & Applications

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	• **Spectroscopic Technique for Water Analysis** –U.V. – Visible spectroscopy FT-IR, Mass Spectrometry, Flame Photometry, X-ray Fluorescence, ICP-OES, Chemiluminescence methods. • **Atomic Absorption and Atomic Fluorescence Spectrometry**-Sample Atomization and Atomic Absorption instrumentation, Interference AAS, Atomic Fluorescence Spectroscopy, Applications. • Atomic Emission Spectrometry- Emission Spectroscopy based on plasma sources, Emission Spectroscopy Based Arc and SparkSources.
3.	**CHROMATOGRAPHIC TECHNIQUES:** (15 Periods) Principle, Instrumentation & Application • **Hyphenated Techniques** - GC-HS 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. • **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.
4.	**ELECTROMETRIC ANALYIS:** (15 Periods) **(A) Capillary Electrophoresis-** Types of electrophoresis, The basis of electrophoresis Separations, Capillary zone and gel electrophoresis, Application. **(B)Electrochemical Techniques-** Principle, Instrumentation and Applications Ion Selective Electrodes & pH metry Coulometry & Potentiometry Conductimetry and Amperometry, Polarography & Voltammetry

Course Outcome: Having Completed this course, the learner will be able to	
1.	Understand fundamental & basic terms involved in ^{1}H NMR, ^{13}C NMR, know effects of various factors on the spectra, interpretation from spectral data, identify structure of organic compounds by using combined spectral data, distinguish isomers and other closely related compounds by using spectral techniques.
2.	Able to understand spectroscopic techniques, Atomic Absorption and Atomic Fluorescence Spectrometry, Atomic Emission Spectrometry for water analysis.
3.	Recognize the use of different stationary and mobile phase for the separation of organic molecule and identify the problems and their solution during the analysis and learn the use of the chromatography for those which can't be identified by the techniques.
4.	Understand the basic theory of coulometer, voltammetry electrogravimetry and their working. Also learn in-depth of coulometry methods and their application in various titrations, Supercritical Fluid Chromatography and ion selective electrodes.

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Suggested Reference Books:

1. Instrumental Analysis by R. D. Braun, McGraw-Hill.
2. Modern Methods of Chemical Analysis (2nd ed.), Pecsok, Shields, Cairns & McWilliam,John Wiley & Sons.
3. High Performance Liquid Chromatography, Dr. P.D. Sethi.
4. Practical NMR Spectroscopy, M.L. Martin, J.J. Delpeuch and G.J. Martin, Heyden.
5. Spectrometric identification of Organic compounds, R.M. Silverstein, G.C. Bassler and T.C. Morrill, John Wiley.
6. Introduction to NMR Spectroscopy, R.J. Abraham, J. Fisher and P. Loftus, Weily.
7. Application of Spectroscopy of Organic compounds, J.R. Dyer, Prentice Hall.
8. Spectroscopy Methods in Organic Chemistry, D.H. Williams, I. Fleming, Tata McGraw-Hill.
9. Spectroscopy of Organic compounds, P.S. Kalsi, New Age International Ltd.
10. Environmental Chemistry, De A.K.
11. Spectroscopy by Jagmohan
12. Analytical Chemistry by Gary D. Christian, Sixth Edition, Wiley Sons.
13. A. Skoog, D.M. West, F.J. Holler, S.R. Crouch, Analytical Chemistry – An Introduction,7th ed. (2000), S. C. Publishing, Philadelphia, London.

On-line resources to be used if available as reference material

Master of Science, Chemistry
M.Sc. Environmental Chemistry, Semester-III
NEP-2020
SYLLABUS TO BE EFFECTIVE FROM DECEMBER-2023
Course Code- EEC-302
Paper-IV: Analysis of Fuel, Food and Water (Elective Paper-2)

Total Credits of the Course	**4**	**Hours per Week**	**4 hrs**

Course Objectives:	• Understand the concepts of fuels, characteristics and classification. To learn efficiency of fuel and their determination. • Learn moisture, mineral matter, and crude fat in foods. Learner should able to understand food adulteration, contamination and additives. • Understand analytical part of monitoring techniques for water analysis such as pH, specific conductance, DO and total hardness. • Understand about methodology for water Analysis in detail. To learn analysis of Tannin, Lignin, E-coli and total bacteria present in water sample.

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Mapping between CO and PSO

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1	■	■	■	■	■				■	■		
CO2	■	■		■	■	■				■	■	■
CO3	■	■	■		■	■			■	■	■	
CO4	■	■			■	■				■	■	■

Unit	Description (4- Credit)
1.	**ANALYSIS OF FUEL** (15 Periods) Modern concepts of fuels, Characteristics and Criterion of selection of good fuel, Classification of Fuel (Solid, liquid and Gaseous), their advantages and disadvantages, Calorific value of Fuels and their determination, Octane number of a fuel
2.	**ANALYSIS OF FOOD** (15 Periods) Moisture, Ash or mineral matter, Crude fat, Crude protein, true protein, non-proteinous nitrogen, crude fiber, carbohydrates, calcium, potassium, sodium and phosphate, food Adulteration and contamination of food and food additives
3.	**MONITORING TECHNIQUES FOR WATER ANALYSIS** (15 Periods) pH, Specific conductance, DO, Ammonia, Nitrate and nitrite, chloride, fluoride, cyanide, sulphide, sulphate and phosphate, Total Hardness (Ca and Mg), Boron , silica.
4.	**METHODOLOGY FOR WATER ANALYSIS** (15 Periods) Metals and metalloids, COD, BOD, Phenols, pesticides, surfactants (Anionic), Tanin and Lignin, E-coli and total bacteria.

Course Outcome: Having Completed this course, the learner will be able to	
1.	Understand the concepts of fuels, characteristics and classification. To learn efficiency of fuel and their determination.
2.	Learn moisture, mineral matter, and crude fat in foods. Learner should able to understand food adulteration, contamination and additives.
3.	Understand analytical part of monitoring techniques for water analysis such as pH, specific conductance, DO and total hardness.
4.	Understand about methodology for water Analysis in detail. To learn analysis of Tanin, Lignin, E-coli and total bacteria present in water sample.

Suggested Reference Books:

1. Analytical Chemistry By Gurdeep R. Chatwal
2. Chemistry for Environmental Engineering and Science By Clair N. Sawyer, Perry L. McCarty Gene F. Parkin.
3. Environmental chemistry By Anil Kumar De and Arnab Kumar De
4. A Textbook of Environment Chemistry and Pollution Control By S.S. Dara and Dr. D.D. Mishra

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On-line resources to be used if available as reference material

Master of Science, Chemistry
M.Sc. Environmental Chemistry, Semester-III
NEP-2020
SYLLABUS TO BE EFFECTIVE FROM DECEMBER-2023
Course Code- OSEC-301
Paper-V: Industrial Safety & Water Analysis Techniques
(Skill Enhancement Course)

Total Credits of the Course	**2**	**Hours per Week**	**2 hrs**

Course Objectives:	• To teach safety parameters, health & welfare to the students. • To create awareness among students regarding Industrial and laboratory accident, its causes & its prevention. • To learn about various water analysis techniques. • To develop advance analytical skills for Quality Checking and Assurance in Laboratories.

Unit	Description (2- Credit)
1.	**INDUSTRIAL SAFETY (15 Periods)** **Risk Assessment:** Process Risk Assessment, Industrial Hygiene Risk Assessment, Environmental Risk Assessment, Fire & Explosive Risk Management **Chemical Storage Safety:** Bulk storage, Solvent storage, Explosive chemical storage, Transportation storage **Static electricity-** its hazards, and control measures **Hazard Identification**, Communication and Symbol
2.	**WATER ANALYSIS TECHNIQUES (15 Periods)** 1. Total Dissolved Solids (TDS) & Total Suspended Solids (TSS) determination 2. Fixed & Total Volatile Solids 3. Fixed Dissolved Solids 4. Mother Liquor Suspended Solids (MSS) & Mother Liquor Volatile suspended Solids (MLVSS) 5. Oil, Grease and phenol determination 6. Chloride and Fluoride determination 7. Kjeldahl's method for ammoniacal nitrogen determination 8. Nitrite and Nitrate determination 9. Phosphate Determination

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	10. Sulphide and sulphate determination 11. Sodium and Potassium determination 12. Chromium determination 13. Fanton process 14. Hydrodynamic Cultivation 15. Microorganism purification
Teaching-Learning Methodology	To meet the effective teaching and the learning requirements, teaching-learning methodology comprise classroom teaching, use of e-resources, library books, IT tools, encouraging students to participatein seminars/ workshops, presentations by students, assignments etc.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written	15 Marks
2.	University External Written Examination	35 Marks

Course Outcome: Having Completed this course, the learner will be able to	
1.	To get skilled to measure risk assessment for hazardous chemical reaction, its monitoring and preventive actions to avoid accidents.
2.	To get skilled for proper chemical segregation and Industrial hygiene management to maintain safety.
3.	To get skilled for analysis of water quality, its sampling, operational techniques, and to produce results.
4.	Students will be able to use the techniques and get skilled necessary for water resource management.

Suggested Reference Books:

1. Fundamentals of Industrial safety and health by Dr. K.U. Mistry, Vol-1&2.
2. Industrial accidental prevention, H. W. Heinrich
3. Encyclopedia of Occupational Health & Safety, ILO, Geneva, Switzerland
4. Accident, Prevention Manual for Industrial Operation, NSC, USA.
5. Analytical methods for drinking water, Advances in sampling and Analysis by Phillippe Quevauviller, K. Clive Thompson.
6. Industrial Water Analysis Handbook by Natrajan Manivasakan.

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VEER NARMAD SOUTH GUJARAT UNIVERSITY

Master of Science, Environmental Chemistry
PRACTICALS
NEP-2020
SYLLABUS TO BE EFFECTIVE FROM DECEMBER-2023
Semester-III
Course Code- EP-301

Total Credits of the Course	**6**	**Hours per Week**	**12 hrs**

Course Objectives:	• To impart basic knowledge for carrying out analysis of some environmental water sample. • Understand the importance of various instrumental techniques in analysis. • To learn about the calculation in analysis. • To learn about the stoichiometry used in analysis of compounds. • Preparation of solution used in determination of variouscompounds.
Mapping between CO and PSO	

	PSO1	PSO2	PSO3	PSO4	PSO5	PSO6	PSO7	PSO8	PSO9	PSO10	PSO11	PSO12
CO1												
CO2												
CO3												
CO4												
CO5												

Course Content	
Major Exercise-A	6-Credit
Viva-Voce	
Major Exercise-B	
Minor Exercise	

Major Exercise-A

Analysis of ternary mixture (minimum six): Types, separation and identification by physical and chemical methods. (S+S+S), (S+S+L), Semisolids or (L+L+L) mixture.

Major Exercise-B: (Minimum 6)

1. Removal of hazardous dyes/metals by Cloud Point Extraction using non-ionic surfactant. [TX-100]
2. Determination of the total salt amount content in given Water using Ion Exchange Chromatography (IEC). (Dowex cation).

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3. Determination of Silica in water sample by Spectrophotometric method.
4. Determination of Fluoride in water sample by Spectrophotometric method
5. Determination of K_{sp} 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 pK_{In} of Methyl red indicator.
8. Determination of pK_{In} of Bromophenol Blue Indicator.
9. Ion-Exchange separation of Fe^{+3} and Co^{+2} and determination Fe^{+3} by Spectrophotometer.
10. Determination of the amount of Fe in Cement by optical method.

Minor Exercise: (Minimum 10)

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

Teaching-Learning Methodology	Introduction, interaction with students in calculation, carrying out experiments at each step according to the respective practical.

Course Outcome: Having Completed this course, the learner will be able to	
1.	Understand the basics to carry out practical.
2.	Done the titration or instrumental method for quantitative analysis.
3.	Done the stoichiometry of the reaction involved in titration.
4.	Draw the graph and find out the unknown concentration by comparison with known compound.
5.	Appreciate good laboratory practices.

M.B. Mathida

Suggested Reference Books:

1. Quantitative Inorganic Analysis including Elementary Instrumental analysis, By A. I.Vogel, 3rd ed., 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; Wiley India Pvt. Ltd.
4. Environmental Pollution, A.K. De
5. Environmental 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.

On-line resources to be used if available as reference material

M.B. Mahida.