MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2025 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College for Women, Perumbavoor					
Faculty/ Discipline	Chemistry					
Programme	BSc (Hons) Chemistry					
Course Coordinator	AISWARIYA K R					
Contributors	Dr.Anu Joy					
Course Name	FUNDAMENTALS OF ENVIRONMENTAL CHEMISTRY					
Type of Course	DSE					
Specialization title	Environmental Analytical Sciences					
Course Code	MG3DSECHEA05					
Course Level	200					
Course Summary	This course introduces undergraduate chemistry students to the fundamental principles of environmental chemistry, focusing on the chemical processes governing the atmosphere, hydrosphere, lithosphere, and biosphere. It explores the chemical nature, sources, reactions, and impacts of pollutants in air, water, and soil systems. The course also introduces environmental toxicants, emerging contaminants, sustainability concepts, and green chemistry principles, fostering environmental awareness and responsible scientific thinking.					
Semester	3	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Describe the scope, importance, and role of chemistry in understanding environmental systems and processes.	U	PO1, PO2, PO3, PO6, PO7, PO8
2	Analyze environmental pollutants and their impact on ecosystems.	An	PO1, PO2, PO3, PO6
3	Discuss environmental toxicants, bioaccumulation, biomagnification, and emerging contaminants.	A	PO1, PO2, PO3, PO6
4	Discuss current environmental issues and evaluate strategies for pollution control.	An	PO1, PO2, PO3, PO6
5	Apply principles of pollution control, sustainability, and green chemistry to address environmental challenges at a conceptual level.	A	PO1, PO2, PO3, PO6

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	1	1	2	-	-	2	2	2	-	-
CO 2	1	2	2	-	-	1	-	-	-	-
CO 3	2	1	1	-	-	2	-	-	-	-
CO 4	1	1	3	-	-	2	-	-	-	-
CO 5	2	3	1	-	-	2	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Environmental Chemistry			
	1.1	Overview of Environmental Chemistry, Importance of Chemistry in Environmental Issues, Brief Overview of the Earth's Atmosphere, Hydrosphere, Lithosphere, and Biosphere	5	["1"]
	1.2	Greenhouse Effect: CO_2, Methane (CH_4), Nitrous oxide (N_2O), Ozone Layer Depletion and its Chemical Causes	4	["1"]
	1.3	Impact of Climate Change on Global Weather Systems, Global Warming Potential and Sustainability Measures	4	["1"]
2	Chemical principles in air, water and soil pollution			
	2.1	Major Components of Air: Nitrogen, Oxygen, CO_2, Noble gases, Air Quality and Common Pollutants: Particulate matter (PM), Nitrogen oxides (NO_x), Sulfur dioxide (SO_2), Ozone (O_3), Atmospheric Chemistry: Formation and degradation of pollutants, Smog Formation and Acid Rain	6	["2"]
	2.2	Water Cycle and Water Quality Parameters (pH, dissolved oxygen, turbidity, etc.), Major Water Pollutants: Heavy metals (Lead, Mercury, Arsenic), Pesticides, Pharmaceuticals, Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), Techniques for Water Purification and Wastewater Treatment	6	["2"]
	2.3	Soil Composition and Structure, Soil Contaminants: Heavy metals, Pesticides, Organic pollutants, Soil pH, Fertility, and Pollution Impact on Agriculture, Techniques for Soil Remediation and Restoration	5	["2"]
3	Current Environmental Issues and Research Trends			
	3.1	Environmental Toxicants: Pesticides, Heavy Metals, Persistent Organic Pollutants (POPs), Bioaccumulation and Biomagnification in Food Chains, Risk Assessment and Management of Toxic Substances	5	["3", "4"]
	3.2	Emerging Contaminants: Microplastics, Nanomaterials, Environmental Impact of Emerging Technologies, Research Directions in Environmental Chemistry	5	["3", "4"]
	3.3	Strategies for Pollution Control: Reduction, Reuse, Recycling, Remediation, Sustainable Chemistry: Green chemistry principles and applications	5	["3", "4"]

Module	Units	Course Description	Hrs	CO No.
4	Environmental Monitoring, Standards and Regulatory Framework			
	4.1	Concept and importance of environmental monitoring. Introduction to environmental impact assessment. Role of chemistry in environmental assessment.	5	["4", "5"]
	4.2	Drinking water quality standards (WHO, BIS – IS 10500). Ambient air quality standards (CPCB, WHO). Soil quality guidelines (basic concepts). Permissible limits and their chemical basis.	5	["4", "5"]
	4.3	Role of chemistry in environmental regulation. Overview of major Indian environmental laws: Water (Prevention and Control of Pollution) Act, Air (Prevention and Control of Pollution) Act, Environment (Protection) Act. Functions of CPCB and SPCBs.	5	["4", "5"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, Discussions, Peer-teaching, Group Discussions

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Assignments, MCQ, Interaction in classroom activities **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) – 5 × 4 = 20 ◦ PART - B ◦ Short Essays - (5 out of 7) – 5 × 7 = 35 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 15 = 15

References

- 1. Manahan, S. E. (2017). Environmental chemistry (10th ed.). CRC Press. 2. Allen, S. E. (1991). Chemical principles of environmental pollution (2nd ed.). Blackwell Scientific Publications. 3. Mackenzie, R. S., & Heath, S. R. (2011). Environmental chemistry: A global perspective (3rd ed.). Pearson Education. 4. Baird, C., & Cann, M. (2011). Environmental chemistry (5th ed.). W.H. Freeman. 5. Harrison, R. M. (2007). Understanding our environment: An introduction to environmental chemistry and pollution (2nd ed.). Royal Society of Chemistry. 6. Rao, C. N. R., & Jugdutt, B. (2007). Environmental chemistry (2nd ed.). Wiley Eastern Ltd. 7. S. D. S. Bhatia (2009). Environmental chemistry. Vishal Publishing Co. 8. Mishra, S. K., & Pande, N. (2009). Environmental chemistry and pollution control. S. Chand Publishing.

Suggested Readings

- 1. Agarwal, A., & Awasthi, S. (2007). Environmental chemistry and pollution control. S. Chand & Company Ltd. 2. Kumar, P. (2011). Environmental chemistry. I.K. International Publishing House. 3. Ghosh, S. K., & Chatterjee, A. (2003). Environmental chemistry: A global approach. New Age International Publishers. 4. Trivedi, R. K., & Goel, P. K. (1986). Chemical and biological methods for water pollution.

Affidavit

- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, Marthoma College for Women, Perumbavoor, agree to appoint a new course coordinator for the proposed Environmental Analytical Sciences in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.
- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.

MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2025 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College for Women, Perumbavoor					
Faculty/ Discipline	Chemistry					
Programme	BSc (Hons) Chemistry					
Course Coordinator	AISWARIYA K R					
Contributors	Dr.Anu Joy					
Course Name	ENVIRONMENTAL TOXICOLOGY					
Type of Course	DSE					
Specialization title	Environmental Analytical Sciences					
Course Code	MG4DSECHEA05					
Course Level	200					
Course Summary	This course introduces undergraduate students to the fundamental concepts of environmental toxicology, focusing on the nature, sources, and effects of toxic substances in the environment. Students gain an understanding of toxicokinetic processes, categories of toxic effects, dose–response relationships, and routes of exposure. The course provides a strong conceptual foundation for advanced studies in environmental chemistry, toxicology, and pollution control.					
Semester	4	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Understand the fundamental principles of toxicology and how toxins interact with biological systems.	U	PO1, PO2, PO3, PO6, PO7, PO8
2	Analyze the mechanisms of toxicity at the cellular and molecular levels, and evaluate their impacts on organisms.	An	PO1, PO2, PO3, PO6
3	Assess the pathways through which toxic substances enter and accumulate in the environment and organisms.	A	PO1, PO2, PO3, PO6
4	Describe toxicity testing methods, types of risk, and basic strategies for management, regulation, and remediation of toxic substances.	An	PO1, PO2, PO3, PO6
5	Analyze real-world environmental toxicology case studies and explain the role of environmental monitoring.	A, An	PO1, PO2, PO3, PO6

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	1	2	2	-	-	1	2	3	-	-
CO 2	2	1	3	-	-	2	-	-	-	-
CO 3	1	1	3	-	-	2	-	-	-	-
CO 4	2	2	1	-	-	3	-	-	-	-
CO 5	2	2	3	-	-	1	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Introduction to Environmental Toxicology			
	1.1	Overview of Toxicology: Definition of toxicology - branches of toxicology and its importance General Principles of Toxicology: Absorption, Distribution, Metabolism, and Excretion, Toxicants and their classifications.	7	["1"]
	1.2	Categories of toxic effects - factors influencing toxicity – toxic effects due to combination of chemicals	5	["1", "3"]
	1.3	Dose response relationship, Routes of Exposure, Target Organs, and Risk Assessment	5	["4"]
2	Toxins in Environment			
	2.1	Toxicology of Common Environmental Pollutants-Heavy Metals: Lead (Pb), Mercury (Hg), Arsenic (As), Pesticides and Herbicides: Mechanisms of Action, Toxicity, and Environmental Impact, Persistent Organic Pollutants (POPs): DDT, PCBs, Dioxins	8	["2", "3"]
	2.2	Ecotoxicology: Impacts of Toxicants on Ecosystems, Aquatic Toxicology: Effects of Pollutants on Aquatic Life, Terrestrial Toxicology	5	["2"]
	2.3	Soil and Agricultural Contaminants, Overview of global environmental toxicology issues and emerging contaminants (conceptual)	5	["2"]
3	Risk Assessment and Management of Toxic Substances			
	3.1	Toxicity tests: LD50 and LC50, Types of risk and steps in risk assessment. Qualitative risk assessment concepts and case studies (no mathematical modeling)	6	["2"]
	3.2	Management of toxic substances - Prevention and control, Regulatory and Legal Measures, Risk management strategies	6	["4"]
	3.3	Toxic Waste Management: Treatment, Disposal, and Remediation Technologies	6	["4"]
4	Case Studies and Monitoring of Toxicants			
	4.1	Case Studies in Environmental Toxicology: Minamata disease Itai–Itai disease, Bhopal Gas Tragedy, Arsenic contamination of groundwater in India	4	["5"]
	4.2	Environmental Monitoring of Toxicants. Biomonitoring and bioindicators. Role of environmental analytical techniques in toxicology.	3	["5"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, Discussions, Peer-teaching, Group Discussions

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Written Tests, Assignments, MCQ, Interaction in classroom activities **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) – 5 × 4 = 20 ◦ PART - B ◦ Short Essays - (5 out of 7) – 5 × 7 = 35 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 15 = 15

References

- 1. Huges W.W., (1996). Essentials of Environmental Toxicology. Taylor and Francis, CRC Press, USA. 2. Richard B Philp., Ecosystems and Human Health: Toxicology and Environmental Hazards, 3rd Edn. CRC Press. 3. Stanley E Manahan (2013). Fundamentals of Environmental and Toxicological Chemistry. Sustainable Science.4thedn. CRC Press. 4. Ted Simon (2014). Environmental Risk Assessment - A Toxicological Approach. CRC Press. 5. Chris Winder and Neill H Stacey., (2004). Occupational Toxicology. 2nd Edition. CRC Press. 6. Cokerham L.G. and Shane, B.S., (1994). Basic Environmental Toxicology. CRC Press, Boca Raton, USA 7. Shaw I.C. and Chadwick J., (1998). Principles of Environmental Toxicology.Taylor & Francis Ltd, London. 8. Landis W., et.al. (2011). Introduction to Environmental toxicology. CRC press, Boca Raton, USA.

Suggested Readings

- 1. Walker, C.H., et.al (2001). Principles of Ecotoxicology. CRC press, Bocaraton, USA. 2. Friend M.A. and Kohn P.J., (2014). Fundamentals of Occupational Health and Safety. Bernan Press, London. 3. Moore, G.S., (2002). Living with the Earth: Concepts in Environmental Health Science. Lewis publishers, Michigan.

Affidavit

- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, Marthoma College for Women, Perumbavoor, agree to appoint a new course coordinator for the proposed Environmental Analytical Sciences in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.
- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.

MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2025 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College for Women, Perumbavoor					
Faculty/ Discipline	Chemistry					
Programme	BSc (Hons) Chemistry					
Course Coordinator	AISWARIYA K R					
Contributors	Dr. Anu Joy					
Course Name	ENVIRONMENTAL SAMPLING & CHEMICAL ANALYSIS					
Type of Course	DSE					
Specialization title	Environmental Analytical Sciences					
Course Code	MG5DSECHEA05					
Course Level	300					
Course Summary	This course provides students with a comprehensive understanding of environmental sampling techniques and analytical methods used for monitoring water, soil, sediment, and air quality. Emphasis is placed on sampling strategies, sample preservation, classical analytical methods, and basic instrumental techniques relevant to environmental chemistry. It also introduces analytical quality control concepts, ensuring reliability and accuracy of environmental data.					
Semester	5	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	This course provides students with a comprehensive understanding of environmental sampling techniques and analytical methods used for monitoring water, soil, sediment, and air quality. Emphasis is placed on sampling strategies, sample preservation, classical analytical methods, and basic instrumental techniques relevant to environmental chemistry. It also introduces analytical quality control concepts, ensuring reliability and accuracy of environmental data.	U	PO1, PO2, PO3, PO6, PO7, PO8
2	Analyze key physical and chemical water quality parameters, soil, sediment and air using standard analytical methods.	An	PO1, PO2, PO3, PO6
3	Utilize classical analytical chemistry techniques for environmental analysis.	A, An	PO1, PO2, PO3, PO6
4	Evaluate analytical data using quality control concepts.	E	PO1, PO2, PO3, PO6

Number of COs		5	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
5	Demonstrate experiments for water quality analysis	A, An	PO1, PO2, PO3, PO6

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	1	2	2	-	-	3	2	3	-	-
CO 2	2	1	2	-	-	3	-	-	-	-
CO 3	2	1	3	-	-	1	-	-	-	-
CO 4	2	3	2	-	-	2	-	-	-	-
CO 5	2	1	3	-	-	1	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Environmental Sampling and Water Analysis			
	1.1	Objectives of environmental sampling. Types of samples: air, water, soil, sediment, biological samples. Grab sampling and composite sampling. Sampling errors and contamination. Preservation, storage, and transportation of samples	5	["1"]
	1.2	Water Sampling - Surface water and groundwater sampling methods. Sampling of drinking water, wastewater, and industrial effluents. Sampling containers and preservatives.	5	["1", "2"]
	1.3	Physical and Chemical Parameters of Water - pH, temperature, turbidity, colour, and odour, Total dissolved solids (TDS) and total suspended solids (TSS). Chemical Analysis of Water - alkalinity and acidity, hardness, Chloride , Dissolved oxygen, Chemical oxygen demand (COD) and biochemical oxygen demand (BOD).	8	["1", "2"]
2	Soil, Sediment and Air Sampling and Analysis			
	2.1	Types of soil samples. Sampling tools and procedures. Preservation and storage.	5	["1", "2"]
	2.2	Determination of soil pH and electrical conductivity. Estimation of organic carbon. Determination of available nitrogen, phosphorus, and potassium (basic concepts), Analysis of heavy metals (introductory methods)	8	["1", "2"]
	2.3	Types of air pollutants. Ambient air sampling methods. Stack sampling and indoor air sampling. Measurement of particulate matter ($PM_{2.5}$ and PM_{10}). Estimation of SO_2 and NO_2 (basic colorimetric methods). Air quality standards (CPCB and WHO).	6	["1", "2"]

Module	Units	Course Description	Hrs	CO No.
3	Basic Analytical Chemistry Techniques			
	3.1	Volumetric Analysis - Acid–base titrations, Redox titrations, Complexometric titrations. Gravimetric Analysis - Principles and applications in environmental analysis.	5	["3"]
	3.2	Colorimetric and Spectrophotometric Methods - Beer–Lambert law, Colorimetric estimation of environmental parameters.	5	["3"]
	3.3	Analytical Quality Control -Accuracy, precision, and sensitivity. Calibration and standard solutions, Detection limits and errors in analysis.	5	["3", "4"]
4	Demonstration Experiments			
	4.1	Sample Collection Methods for Environmental Monitoring (Water, Soil), Water Quality Analysis - pH , electrical conductivity, turbidity, total dissolved solids , alkalinity, acidity, hardness, chloride, Soil pH and organic carbon analysis.	8	["5"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, Group Discussions, Peer-teaching, Demonstration Experiments

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Written Tests, Assignments, MCQ, Interaction in classroom activities **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) – 5 × 4 = 20 ◦ PART - B ◦ Short Essays - (5 out of 7) – 5 × 7 = 35 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 15 = 15

References

- 1. Dhara S.S., (1993). A Text book on environmental chemistry and pollution control, S Chand Publishers, New Delhi. 2. Goel, P.K., (1997). Water pollution; causes, effects and control, New Age Int Pvt. Ltd. 3. Khitoliya R.K., (2004). Environmental pollution, S. Chand and Company Ltd. New Delhi. 4. Kaushik A., (2004). Perspectives in Environmental studies, New Age Intl. Pub, New Delhi. 5. Tyagi A., Environmental science, Danika publishing company, New Delhi. 6. Deshwal S. and Deswal A., (2004). A basic course in environmental studies, Dhanpat Rai & Co, Delhi. 7. Biswas T.D. and Mukherji S., (1994). A Text book on soil science, Tata Mc Graw Hill Publishing Company, New Delhi. 8. Sharma B.K., (1994). Environmental chemistry, Goel publishing company, Meerut.

Suggested Readings

- 1. Allen, S. E. (1991). Chemical principles of environmental pollution (2nd ed.). Blackwell Scientific Publications. 2. Harrison, R. M. (2007). Understanding our environment: An introduction to environmental chemistry and pollution (2nd ed.). Royal

Society of Chemistry. 3. Mishra, S. K., & Pande, N. (2009). Environmental chemistry and pollution control. S. Chand Publishing. 4. Agarwal, A., & Awasthi, S. (2007). Environmental chemistry and pollution control. S. Chand & Company Ltd.

Affidavit

- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, Marthoma College for Women, Perumbavoor, agree to appoint a new course coordinator for the proposed Environmental Analytical Sciences in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.
- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.

MAHATMA GANDHI UNIVERSITY

Kottayam, Kerala

Undergraduate Programmes (HONOURS)
2025 Admission Onwards

SYLLABUS						
SIGNATURE COURSE						
Name of the College	Marthoma College for Women, Perumbavoor					
Faculty/ Discipline	Chemistry					
Programme	BSc (Hons) Chemistry					
Course Coordinator	AISWARIYA K R					
Contributors	Dr.Anu Joy					
Course Name	ADVANCED ENVIRONMENTAL ANALYTICAL TECHNIQUES					
Type of Course	DSE					
Specialization title	Environmental Analytical Sciences					
Course Code	MG6DSECHEA05					
Course Level	300					
Course Summary	This course provides an in-depth understanding of advanced analytical and instrumental techniques used in environmental analysis. It covers the principles, instrumentation, and applications of chromatographic methods and advanced spectroscopic techniques and emerging analytical technologies for the analysis of heavy metals and organic contaminants. Emphasis is placed on real-world environmental applications, enabling students to understand modern tools used in pollution monitoring, environmental assessment, and sustainable environmental management.					
Semester	6	**Credits**			4	**Total Hours**
Course Details	**Learning Approach**	Lecture	Tutorial	Practical	Others	
		4		0		60
Pre-requisites, if any						

Course Outcomes (CO)

Number of COs		**5**	
CO No.	**Expected Course Outcome**	**Learning Domains ***	**PO No**
1	Explain the principles, instrumentation, and working of chromatographic techniques	U	PO1, PO2, PO3, PO6, PO7, PO8
2	Identify and select appropriate chromatographic detectors for the analysis of environmental pollutants	A	PO1, PO2, PO3, PO6
3	Describe the theory and applications of advanced atomic spectroscopic techniques.	U, A	PO1, PO2, PO3, PO6
4	Apply molecular spectroscopic methods for the identification and quantitative estimation of organic pollutants in environmental samples.	A	PO1, PO2, PO3, PO6
5	Apply molecular spectroscopic methods for the identification and quantitative estimation of organic pollutants in environmental samples.	An, E	PO1, PO2, PO3, PO6

**Remember (K), Understand (U), Apply (A), Analyse (An), Evaluate (E), Create (C), Skill (S), Interest (I) and Appreciation (Ap)*

CO-PO Articulation Matrix

CO/PO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10
CO 1	1	3	2	-	-	1	2	3	-	-
CO 2	2	3	1	-	-	2	-	-	-	-
CO 3	1	2	3	-	-	2	-	-	-	-
CO 4	2	1	3	-	-	3	-	-	-	-
CO 5	1	1	2	-	-	3	-	-	-	-

'0' is No Correlation, '1' is Slight Correlation (Low level), '2' is Moderate Correlation (Medium level) and '3' is Substantial Correlation (High level).

Course Content

Content for Classroom transaction (Units)

Module	Units	Course Description	Hrs	CO No.
1	Chromatographic Techniques in Environmental Analysis			
	1.1	Gas Chromatography: Principle and instrumentation. Detectors- FID, ECD. Analysis of VOCs, pesticides, PCBs.	6	["1", "2"]
	1.2	High Performance Liquid Chromatography - Normal phase and reversed phase HPLC. Detectors: UV, fluorescence. Analysis of phenols, dyes, and pharmaceuticals.	7	["1", "2"]
	1.3	GC–MS and LC–MS (basic concepts) - Importance in confirmation and identification of pollutants.	6	["1", "2"]
2	Advanced Spectroscopic Techniques			
	2.1	Atomic Spectroscopy - Atomic Absorption Spectroscopy (AAS), Flame and Graphite Furnace AAS, Applications in heavy metal analysis. Inductively Coupled Plasma Techniques - ICP–AES and ICP–MS.	7	["3", "4"]
	2.2	Molecular Spectroscopy - UV–Visible spectroscopy in environmental analysis. Infrared spectroscopy for identification of organic pollutants. Fluorescence spectroscopy and its environmental applications	7	["3", "4"]
3	Advanced and Emerging Analytical Technologies			
	3.1	Mass Spectrometry - Basic principle of mass spectrometry, Environmental applications of MS.	7	["4", "5"]
	3.2	Sensors and Biosensors - Electrochemical sensors for air pollutants, Biosensors for pesticides and heavy metals. Remote Sensing and GIS - Principles of remote sensing, Applications in environmental pollution monitoring.	7	["5"]
	3.3	Thermal and Surface Techniques - Thermal analysis (TGA, DSC) for waste characterisation, X-ray fluorescence (XRF) for elemental analysis.	7	["5"]
4	Quality Assurance, Data Analysis, and Regulations			
	4.1	Calibration and standardization of instruments. Accuracy, precision, sensitivity, and detection limits	3	["5"]
	4.2	Quality control and quality assurance (QA/QC). Environmental standards: WHO, CPCB, EPA. Interpretation and reporting of environmental data.	3	["5"]

Teaching and Learning Approach	Classroom Procedure (Mode of transaction) Lectures, Group Discussions, Peer-teaching

Assessment Types	**MODE OF ASSESSMENT** Mode of Assessment: Theory **A. Continuous Comprehensive Assessment (CCA)** **• Theory – 30 Marks** Written Tests, Assignments, MCQ, Interaction in classroom activities **B. End Semester Evaluation (ESE)** **• Theory – 70 Marks** Assessment Methods – Written Examination Duration of Examination – 2.00 Hrs Pattern of examination for Theory – Non-MCQ Different parts of written examination – Part - A , B , C Answer Type: ◦ PART - A ◦ Short answer - (5 out of 7) – 5 × 4 = 20 ◦ PART - B ◦ Short Essays - (5 out of 7) – 5 × 7 = 35 ◦ PART - C ◦ Essays - (1 out of 2) – 1 × 15 = 15

References

- 1. Skoog, D. A., Holler, F. J., & Crouch, S. R. Principles of Instrumental Analysis, 6th / 7th Edition, Cengage Learning. 2. Chatwal, G. R., & Anand, S. K. Instrumental Methods of Chemical Analysis, Himalaya Publishing House. 3. B. K. Sharma. Instrumental Methods of Chemical Analysis, Goel Publishing House. 4. Manahan, S. E. Environmental Chemistry, 10th Edition, CRC Press. 5. Snyder, L. R., Kirkland, J. J., & Dolan, J. W.Introduction to Modern Liquid Chromatography, Wiley. 6. McNair, H. M., & Miller, J. M. Basic Gas Chromatography, Wiley. 7. Welz, B., & Sperling, M. Atomic Absorption Spectrometry, Wiley-VCH. 8. APHA (1985) Standard methods for examination water and waste water. American public health association. New York.

Suggested Readings

- 1. Montaser, A. Inductively Coupled Plasma Mass Spectrometry, Wiley. 2. Banica, F. G. Chemical Sensors and Biosensors, Wiley. 3. Hoffmann, E. de, & Stroobant, V. Mass Spectrometry: Principles and Applications, Wiley.

Affidavit

- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, retain the copyright of this syllabus and expressly prohibit its distribution in complete form to any institution outside our own.
- We, Marthoma College for Women, Perumbavoor, agree to appoint a new course coordinator for the proposed Environmental Analytical Sciences in the event of the unavailability of the currently nominated coordinator. This appointment will ensure the continued coordination of course delivery, assessments, and all related academic responsibilities necessary for the successful implementation of the specialization, for as long as the college offers this programme.
- We, Marthoma College for Women, Perumbavoor and AISWARIYA K R, declare that no part of this signature course submitted here for approval has been taken from the course content developed by, or from any of the course titles prepared by, the BoS/expert committee in the same discipline under our University.