

ANNA UNIVERSITY, CHENNAI
NON- AUTONOMOUS COLLEGES
AFFILIATED TO ANNA UNIVERSITY
M. TECH., ENVIRONMENTAL SCIENCE AND TECHNOLOGY
REGULATIONS 2025

PROGRAMME OUTCOMES (POs):

PO	Programme Outcomes
PO1	An ability to independently carry out research /investigation and development work to solve practical problems
PO2	An ability to write and present a substantial technical report/document.
PO3	Students should be able to demonstrate a degree of mastery over the area as per the specialization of the program. The mastery should be at a level higher than the requirements in the appropriate bachelor program

PROGRAMME SPECIFIC OUTCOMES(PSOs):

PSO	Programme Specific Outcomes
PSO1	Apply scientific and analytical skills to solve complex environmental problems.
PSO2	Design and evaluate sustainable technologies considering economic, social, and environmental factors.



ANNA UNIVERSITY, CHENNAI

POST GRADUATE CURRICULUM (NON-AUTONOMOUS AFFILIATED INSTITUTIONS)

Programme: M. Tech., Environmental Science and Technology

Regulations: 2025

Abbreviations:

BS – Basic Science (Mathematics)
ES – Engineering Science (General (**G**),
 Programme Core (**PC**), Programme
 Elective (**PE**))
SD – Skill Development
SL – Self Learning
OE – Open Elective

L – Laboratory Course
T – Theory

LIT – Laboratory Integrated Theory
PW – Project Work
TCP – Total Contact Period(s)

Semester I

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.	ES25101	Unit Operations and Unit Processes in Environmental Technology	T	3	0	0	3	3	ES (PC)
2.	ES25102	Biological Wastewater Treatment	T	3	0	0	3	3	ES (PC)
3.	ES25103	Air and Noise Pollution Control	T	3	0	0	3	3	ES (PC)
4.	ES25104	Environmental Monitoring and Analysis	T	3	0	0	3	3	ES (PC)
5.	ES25105	Environmental Impact Assessment	T	3	0	0	3	3	ES (PC)
6.	ES25106	Environmental Engineering Lab I	L	0	0	4	4	2	SD
7.	ES25107	Technical Seminar	-	0	0	2	2	1	SD
Total Credits							21	18	

Semester II

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.		Separation Processes in Environmental applications	T	3	0	0	3	3	ES (PC)
2.		Solid and Hazardous Waste Management	T	3	0	0	3	3	ES (PC)
3.		Environmental Policies and Legislation	T	3	0	0	3	3	ES (PC)
4.		Industry Oriented Course I	----	1	0	0	1	1	SD
5.		Programme Elective I	T	3	0	0	3	3	ES (PE)
6.		Programme Elective II	T	3	0	0	3	3	ES (PE)
7.		Environmental Engineering Lab II	L	0	0	4	4	2	SD
8.		Separation Processes Lab	L	0	0	4	4	2	SD
9.		Self Learning Course	--	-	-	-	-	1	-
Total Credits							24	21	

#* Evaluation will be done in third semester for the summer internship.

Semester – III

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
THEORY									
1.		Modelling of Environmental Systems	T	3	1	0	4	4	ES (PC)
2.		Industrial Pollution Prevention Strategies	T	3	0	0	3	3	ES (PC)
3.		Industry Oriented Course II	----	1	0	0	1	1	SD
4.		Programme Elective III	T	3	0	0	3	3	ES (PE)
5.		Programme Elective IV	T	3	0	0	3	3	ES (PE)
6.		Open Elective	---	3	0	0	3	3	---
7.		Project Work I	---	0	0	12	12	6	SD
Total Credits							29	23	

Semester IV

S. No.	Course Code	Course Title	Type	Periods per week			TCP	Credits	Category
				L	T	P			
1.		Project Work II	---	0	0	24	24	12	SD
Total Credits							24	12	

Programme Elective Courses (PE)

S. No.	Course Code	Course Title	Periods			Total Contact Periods	Credits
			L	T	P		
1		Ecology and Environment	3	0	0	3	3
2		Environmental Risk Assessment	3	0	0	3	3
3		Risk Analysis and Hazop	3	0	0	3	3
4		Environmental Nanotechnology	3	0	0	3	3
5		Sustainable Management	3	0	0	3	3
6		Design of Experiments	2	0	2	4	3
7		Green Chemistry and Engineering	3	0	0	3	3
8		Environmental Sustainability	3	0	0	3	3
9		Principles of Cleaner Production	3	0	0	3	3
10		Advanced Oxidation Processes and Technology	3	0	0	3	3
11		Electrochemical Environmental Technology	3	0	0	3	3
12		Industrial Instrumentation	3	0	0	3	3
13		Remote Sensing and GIS Applications in Environmental Management	3	0	0	3	3
14		Soil Remediation Technologies	3	0	0	3	3
15		Environmental Health and Safety in Industries	3	0	0	3	3
16		Environmental Management	3	0	0	3	3
17		Environmental Biotechnology	3	0	0	3	3
18		Waste Management and Energy recovery	3	0	0	3	3
TOTAL CREDITS							37

Semester I

ES25101	Unit Operations and Unit Processes in Environmental Technology	L	T	P	C
		3	0	0	3
Course Objective: - To make the students understand the applications of unit operations and processes in environmental technology. - To enable the students to recognize the basic concept on mixing - coagulation and flocculation. - To enable the students to apprehend the concept of filtration and its applications. - To impart knowledge on the concept of chemical precipitation and adsorption. - To understand applications of aerobic and anaerobic process in the wastewater treatment.					
Overview Process Selection: Process Selection, Performance, Reliability, and Resiliency, Technology Assessment and Implementation, Principal type of Reactors, Materials Balance: Concept, Screening Comminutors.					
Activity: Compare different reactors for a given treatment scenario and justify selection.					
Mixing – Coagulation Mixing, Coagulation and Flocculation, Flow equalization, Theories of Destabilization, Sedimentation, Type of settling, Removal ratio, Clarifier-thickener, Column flotation- air flotation.					
Activity: Conduct jar tests for coagulation and flocculation; analyze sedimentation rates.					
Filtration: Filtration, Theory of Filtration, classification of filters, Total Head-Loss, Layout of Filters, Backwash, Hydraulic Loading, Darcy equation.					
Activity: Demonstration of various filtration equipment.					
Chemical Precipitation: Chemical precipitation, phosphate removal, Adsorption, Activated carbon, Isotherms, Disinfection, Factors Influencing, Breakpoint chlorination, De chlorination.					
Activity: Perform adsorption experiments using activated carbon.					
Aerobic and Anaerobic Process: Kinetics of Biological growth, Suspended and attached growth processes, Aerobic and Anaerobic, Determination of kinetic coefficients.					
Activity: Demonstration of Aerobic and Anaerobic process.					
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%					
Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)					
References: - Reynolds, D., & Richards, A. (1996). <i>Unit Operations and Processes in Environmental Engineering</i> (2nd ed.). PWS Publishing Company. - Theodore, L., Dupont, R., & Ganesan, K. (2017). <i>Unit Operations in Environmental Engineering</i>. Wiley.					

3. McCabe, W. L., Smith, J. C., & Harriott, P. (2005). *Unit Operations of Chemical Engineering*. McGraw-Hill Education.
4. Geankoplis, C. J. (2015). *Transport Processes and Separation Process Principles*. Pearson.
5. Metcalf & Eddy, Inc. (2003). *Wastewater Engineering: Treatment and Reuse*. Tata McGraw-Hill Publishing Company.

	Description of CO	PO	PSO1	PSO2
CO1:	Select appropriate wastewater treatment processes and reactor types.	PO1(3), PO2(2)	3	2
CO2:	Apply principles of mixing, coagulation, and sedimentation in water treatment.	PO3(1), PO2(2)	2	3
CO3:	Design filtration systems using hydraulic principles and Darcy's law.	PO1(1), PO3(2)	2	1
CO4:	Analyze biological treatment kinetics for both aerobic and anaerobic processes.	PO3(3)	2	2

ES25102	Biological Wastewater Treatment	L	T	P	C
		3	0	0	3
Course Objective: • To make students learn about the methods used for the treatment of wastewater biologically. • To enable the students to understand the need for aerobic and anaerobic process in sludge management. • To make the students understand modelling and design aspects of biological techniques available. • To impart knowledge on operational mechanism of suspended and attached growth reactors. • To educate the students on the aspects of various biological methods in the real-time effluent treatment.					
Fundamental of Biochemical Operations: Objectives of biological wastewater treatment, pollutants characteristics; fundamental, classification and overview of biochemical operations, major types of microorganism and their role, microbial eco system and interactions Activity: Identify and classify microorganisms from wastewater samples; discuss their roles in treatment.					
Aerobic / Anerobic Process and Sludge Management: Aerobic/anoxic and anaerobic process. Aerobic digestion – overview, performance factors, design and operations; Anaerobic processes: background, role and operation process. Sludge Management: Sludge characteristics, production, stabilization; thickening and dewatering; pathogen removal; sludge transformation and disposal methods. Activity: Demonstrate aerobic and anaerobic digestion processes in the lab.					
Suspended Growth Reactors: Principles of suspended Growth Systems, types: Activated Sludge process; types, design and operations; Biological Nutrient Removal: phosphorus and nitrogen removal; aerated lagoons, waste stabilization ponds. Activity: Visit near by biological waste water treatment unit.					
Attached Growth Reactors: Submerged Attached Growth Bioreactors, Membrane biological reactors-Trickling Filters, bio tower, rotating biological contactor, moving bed reactors, fluidized bed reactors – role and process options. Activity: Build and test a model of a trickling filter or rotating biological contactor.					
Industrial Application Case Studies: Future Challenges: fate and effects of Xenobiotic organic chemicals, Industrial application of biological reactor for wastewater treatment – Case studies: Distillery, Sugar, Pulp and paper, Textile, Dairy, Fertilizer, Pesticides, Pharmaceutical, starch etc.,					

Activity: Research and present on biological treatment applications in industries such as textile or pharmaceutical.

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References:

1. Grady, C. P. L., Daigger, G. T., & Lim, H. C. (1999). *Biological wastewater treatment*. Marcel Dekker.
2. Hendricks, D. (2011). *Fundamentals of water treatment processes*. CRC Press.
3. Metcalf & Eddy, Inc. (2003). *Wastewater engineering: Treatment and reuse*. Tata McGraw-Hill.
4. Mizrahi, A. (1989). *Biological waste treatment*. Wiley.
5. Patwardhan, A. D. (2008). *Industrial wastewater treatment*. Prentice Hall of India.
6. Spellman, F. R. (2009). *Handbook of water and wastewater treatment plant operations*. CRC Press.

	Description of CO	PO	PSO1	PSO2
CO1:	Explain microbial roles and principles in biological wastewater treatment.	PO1(3), PO2(2)	3	2
CO2:	Distinguish between aerobic and anaerobic processes and sludge handling.	PO3(1), PO2(2)	2	1
CO3:	Design and operate suspended and attached growth reactor systems.	PO1(1), PO3(2)	2	3
CO4:	Analyze real-world applications of biological wastewater treatment technologies.	PO3(3)	2	2

ES25103	Air and Noise Pollution Control	L 3	T 0	P 0	C 3
Course Objective: • To impart knowledge on the air pollution sources, characteristics and effects of air and noise pollution • To enable the students to learn the methods of controlling the air pollution. • To impart knowledge on source inventory and control mechanism. • To enable the students to learn the dispersion mechanisms and models • To enable the students to learn the health effects and control of noise pollution					
Introduction to Air Quality: Types of air pollution, Air pollution effects, Air pollution control laws and regulations An Overview of the Clean Air Act Amendments; Fate and Transport in the Environment; Priority Air Pollutants; Indoor Air Quality. Properties of Air Pollutants; Selected Chemical and Physical Properties of Potential Atmospheric Pollutants; Air pollution measurements Basic Properties and Terminology. Activity: Measure and analyze local air quality data using online resources or sensors.					
Industrial Air Pollution Sources and Prevention: Air Pollution in the Chemical Process industries, Petroleum, Iron and Steel Manufacturing, Lead and Zinc Smelting Industries, Air Pollution from Nickel Ore Processing and Refining; Air Pollution from Copper Smelting industries Activity: Visit or research an industrial site to identify major air pollution sources and prevention methods.					
Ventilation and Indoor Air Quality Control: An Overview of Indoor Air Quality; The Basics of HVAC Systems; IAQ Issues and Impacts on Occupants; Application of Audits to Developing an IAQ Profile; Developing Management Plans; IAQ Problems; Control; Quantification and Measurement, Air Pollution Dispersion-Dispersion Theory Basics-Air Quality Impact of Stationary Sources-Air pollution concentration Models and Resources. Activity: Conduct an indoor air quality audit in a classroom or office and suggest improvements.					
Prevention Versus Control: Pollution Prevention: Principles of Pollution Prevention; Control methods of particulates, VOCs and gaseous pollutants, Environmental Cost Accounting; Total Cost Accounting. Activity: Evaluate different pollution control technologies for particulates and VOCs through case studies.					
Noise Pollution: Noise pollution and its causes, effects measurement and control, Regulations and Laws of Noise pollution, sound level-measuring transient noise-acoustic environment health effects of noise–noise control. Introduction to cosmic pollution. Activity: Measure ambient noise levels using a sound level meter and analyze noise pollution sources.					

Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References:

1. Anjaneyulu, Y. (2002). *Air pollution and control technologies*. Allied Publishers.
2. Davis, W. T. (2000). *Air pollution engineering manual*. Wiley.
3. De Nevers, N. (2011). *Air pollution control engineering*. McGraw-Hill.
4. Liu, D. H. F., & Lipták, B. G. (2000). *Air pollution*. Lewis Publishers.
5. Sharma, N., Kumar, A., & Singh, A. P. (2018). *Air pollution control*. Springer Nature.
6. Stern, A. C. (2006). *Air pollution* (Vols. I–VIII). Academic Press.
7. Wang, L. K., Pereira, N. C., & Hung, Y.-T. (2005). *Advanced air and noise pollution control engineering* (Vol. 2).

	Description of CO	PO	PSO1	PSO2
CO1:	Identify sources and effects of air and noise pollution along with applicable regulations.	PO1(3), PO2(2)	3	2
CO2:	Explain industrial air pollution control methods and indoor air quality systems.	PO3(1), PO2(2)	2	1
CO3:	Apply dispersion models to evaluate air pollution impact.	PO1(1), PO3(2)	2	3
CO4:	Analyze noise pollution parameters and implement control techniques.	PO3(3)	3	2

ES25104	Environmental Monitoring and Analysis	L	T	P	C
		3	0	0	3
Course Objective: • To enable the students to learn the environmental compartments and their interactions. • To impart knowledge on the various monitoring parameters in water and air. • To enable the students to detect the composition of various types of solid samples. • To impart knowledge on environmental laws and regulatory standards. • To enable the students to learn practically about sampling and measurement of relevant parameters for environmental samples.					
Analysis of Environmental Parameters: Introduction, Environmental compartments. Composition of the environmental phases: Water, Air, Earth (soil / sediment). Markers and benchmarks for toxicology and environmental health. Partition constants. Activity: Test soil, water, and air samples for basic environmental parameters using simple kits or datasets.					
Water Quality Assessment and Management: Water & Wastewater Quality. Exposure pathways, health effects. Physical and chemical characteristics of water / waste water. Composition of water. Sampling, monitoring and analysis techniques. Activity: Collect and analyze water samples for pH, turbidity, and contaminants; discuss health implications.					
Air Pollution Analysis and Control: Air Quality. Composition of the atmosphere. Common air pollutants – particulate and vapours. Criteria for ambient air quality. Exposure pathways, health effects. Measurement and characterization of ambient air quality parameters. Particulate matter – PM _x definition – aerodynamic diameter; Gas phases samplers, impingers, adsorbents, instrumentation. Activity: Measure local air quality (PM levels, gases) using portable monitors or data sources; interpret results.					
Management of Solid Waste: Composition of solid waste. Characterization techniques. Domestic and industrial solid waste. Activity: Conduct a waste audit at home or campus to classify and quantify solid waste types.					
Environmental Disasters and Regulations: Regulatory standards and agencies (International and national); Environmental disasters – affecting multiple phases. Methods for establishing ambient regulatory standards. Activity: Research a major environmental disaster and present the regulatory response and outcomes.					
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%					

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References:

1. Manahan, S. E. (2004). *Environmental chemistry* (8th ed.). CRC Press.
2. Peavy, H. S., Rowe, D. R., & Tchobanoglous, G. (1985). *Environmental engineering*. McGraw-Hill.
3. Seinfeld, J. H., & Pandis, S. N. (2016). *Atmospheric chemistry and physics: From air pollution to climate change*. Wiley.
4. Thibodeaux, L. J. (1996). *Environmental chemodynamics: Movement of chemicals in air, water, and soil* (2nd ed.). Wiley.
5. Thibodeaux, L. J., & Mackay, D. (Eds.). (2010). *Handbook of chemical mass transport in the environment*. CRC Press.

	Description of CO	PO	PSO1	PSO2
CO1:	Explain environmental compartments and essential parameters for pollution monitoring.	PO1(3), PO2(2)	2	3
CO2:	Assess water quality using various physical, chemical, and biological tests.	PO3(1), PO2(2)	1	3
CO3:	Analyze ambient air quality and recommend control methods for pollutants.	PO1(1), PO3(2)	3	1
CO4:	Characterize solid waste types and evaluate environmental disaster management.	PO3(3)	3	2

ES25105	Environmental Impact Assessment	L	T	P	C
		3	0	0	3
OBJECTIVES • To educate the students about the importance of Environmental Impact Assessment • To make the students understand the methods followed for the impact assessment. • To enable the students to learn historical evolution of EIA and to update on latest trends and improvements • To impart knowledge on the methods for the effective EIA report writing • To enable the students to learn and apply from existing EIA reports of projects					
Components and Types Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS), Environmental Risk Assessment (ERA), Legal and Regulatory aspects in India, Types and limitations of EIA, screening and scoping, Terms of Reference in EIA. Activity: Review and summarize an existing Environmental Impact Statement (EIS) from a local project.					
Impact Prediction and Analysis Components, setting Impact analysis, prediction of impacts, mitigation. Important assessment techniques methods for Prediction and assessment of impacts -Matrices, Networks, Checklists; Impacts – air, water, soil, noise, biological, cultural, social, economic environments; Standards and guidelines for evaluation; cost benefit analysis; analysis of alternatives. Activity: Use checklists or matrices to predict environmental impacts for a hypothetical project.					
Trends and Developments in EIA Public Participation in environmental decision making; trends in EIA practice- strategic environmental assessment; Expert system in EIA; capacity building for quality assurance; use of regulations and AQM; Issues and limitations of EIA. Activity: Organize a debate or discussion on public participation and limitations of current EIA practices.					
Report Writing and Post EIA Document planning - collection and organization of relevant information, use of visual display materials, team writing' reminder checklists. Environmental monitoring – guidelines, policies, planning; Environmental Management Plan; Post-project audit. Activity: Prepare a brief environmental management plan based on a given case study.					
Case Studies Case studies of EIA of developmental projects; Project report on EIA case study. Activity: Analyze and present a real-world EIA report for a developmental project.					
Weightage: Continuous Assessment: 40%, End Semester Examinations: 60%					

Assessment Methodology: Quiz (20%), Assignments (30%), Internal Examinations (50%)

References:

1. Canter, L. W. (1996). *Environmental Impact Assessment*. McGraw-Hill, New York.
2. Petts, J. (2009). *Handbook of Environmental Impact Assessment* (Vols. I & II). Blackwell Science, London.
3. The World Bank Group. (1991). *Environmental Assessment Sourcebook* (Vols. I, II & III). The World Bank, Washington, D.C.
4. Lawrence, D. P. (2003). *Environmental Impact Assessment: Practical Solutions to Recurrent Problems*. Wiley-Interscience, New Jersey.
5. Marriott, B. (1997). *Environmental Impact Assessment: A Practical Guide*. McGraw-Hill.
6. Wathern, P. (1990). *Environmental Impact Assessment: Theory and Practice*. Routledge Publishers.
7. EIA Notification 2006, India

	Description of CO	PO	PSO1	PSO2
CO1:	Explain the key components and legal framework of Environmental Impact Assessment (EIA).	PO1(3), PO2(2)	3	2
CO2:	Apply various techniques like matrices and checklists to predict environmental impacts.	PO3(1), PO2(2)	1	2
CO3:	Evaluate current trends, challenges, and public participation in EIA processes.	PO1(1), PO3(2)	2	2
CO4:	Develop environmental management plans and design effective post-project monitoring.	PO3(3)	3	2

ES25106	Environmental Engineering Lab - I	L	T	P	C
		0	0	4	2
OBJECTIVES • To enable the students to understand the principles of instrumental methods of analysis in environmental application. • To impart skills in the scientific method of planning, conducting, reviewing, reporting experiments and problem solving in environmental analysis. • To make students identify and apply correct techniques for the analysis of environmental samples					
Exercises 1. Coagulation study 2. Estimation of chlorine dosage and determination of break point for samples. 3. Studies on filtration 4. Settling Characteristics 5. Batch absorption kinetics 6. Column absorption studies 7. Decoloration study using UV-Spectrophotometer 8. Heavy Metal absorption using AAS 9. Organic compound degradation using HPLC 10. Demonstration of GC, FTIR and Lyophilizer					
Weightage: Continuous Assessment: 60%, End Semester Examinations: 40%					
Assessment Methodology: Project (30%), Assignment (10%), Practical (30%), Internal Examinations (30%)					
References: 1. Association of Environmental Engineering and Science Professors Foundation. (2002). AEESP environmental processes laboratory manual. Washington, DC: Author. 2. American Public Health Association, American Water Works Association, & Water Environment Federation. (2012). Standard methods for the examination of water and wastewater. Washington, DC: American Public Health Association. 3. Lee, C. C., & Lin, S. (2007). Handbook of environmental engineering calculations. New York, NY: McGraw-Hill. 4. Metcalf & Eddy, Inc. (2003). Wastewater engineering: Treatment and reuse. New York, NY: McGraw-Hill. 5. Sawyer, C. N., McCarty, P. L., & Parkin, G. F. (2003). Chemistry for environmental engineering. New Delhi, India: Tata McGraw-Hill.					

	Description of CO	PO	PSO1	PSO2
CO1:	Conduct key water treatment experiments including coagulation, filtration, and settling.	PO1(3), PO2(2)	3	2
CO2:	Analyze contaminant removal using absorption kinetics and advanced analytical instruments.	PO3(1), PO2(2)	2	3
CO3:	Demonstrate practical knowledge of instrumental techniques like UV-Vis, AAS, HPLC, GC, and FTIR.	PO1(1), PO3(2)	3	1