

Branch Name:	Environment Engineering
Program Code:	ET212
Subject Title:	Advanced Wastewater Treatment Technologies
Subject Code:	2ET2120403T
Pre-requisite Subject:	Knowledge of physic-chemical and biological treatment of wastewater

Course Objective:

- Satisfying the stringent standards for disposal of treated effluents in various sinks
- Reusing/ recycling of treated effluents for different uses require that the wastewater be given more exhaustive and advanced treatment.
- To give knowledge to the students regarding advanced wastewater treatment technologies.

Teaching and Examination Scheme:

Credit	Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)								
					Theory (Marks)				Practical (Marks)				Total (Marks)
	L	T	P	Total	SEE		CCA		SEE		CCA		
					Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	
4	3	1	-	4	24	60	16	40	-	-	-	-	100

Subject Contents				
Sr. No	Topic	Total Hours	Weightage (%)	
1	Need of Advanced Wastewater Treatment, Applications of Advanced Wastewater Treatment	3	8	
2	Nutrient Removal Nitrogen Removal: Nitrification, Denitrification Simultaneous nitrification and denitrification Phosphorus Removal: Introduction, Phosphorus removal by Chemical, biological methods	9	20	
3	Adsorption Introduction, Fundamentals of adsorption, Type of adsorbents Development of adsorption isotherms: Freundlich, Langmuir, BET Activated carbon adsorption, Granular carbon adsorption	6	15	
4	Membrane Filtration Membrane Process Classification and operation: Microfiltration, Ultrafiltration, Nano filtration, Reverse Osmosis, Electrodialysis Membrane Configurations: Plate-and-frame module, Spiral-wound module, Tubular module, Hollow-fiber module Membrane Fouling: Modes of membrane fouling, Control of membrane fouling Application of membrane processes	11	25	

5	Ion Exchange: Fundamentals of Ion Exchange, Types of Ion Exchange Resins for wastewater treatment, Theory of Ion Exchange Applications: Removal and recovery of heavy metals, Removal of nitrogen, Removal of phosphorus , Organic chemical removal	7	17
6	Advanced Oxidation Processes: Theory of advanced oxidation, Types of oxidizing agents, ozone based and non-ozone-based processes, Fenton and photo-Fenton Oxidation, Solar Photo Catalytic Treatment Systems	6	15

Reference Books:

1. Waste water Engineering: Treatment and Disposal by Metcalf & Eddy
2. Environmental Engineering- Peavy, Rowe & Tclobaloglous
3. Membrane Systems for Wastewater Treatment –Water Environment Federation
4. Membrane Separation Processes by Kaushik Nath

List of Open-Source Software/learning website:

1. <https://nptel.ac.in/>

Course Learning Outcomes (CLO): On completion of this course, the students will be able to:

CLO	Description	Bloom's Taxonomy Level
CLO1	To understand the advanced wastewater treatment process	L-2
CLO2	To apply various method for removing of nutrients from wastewater.	L-3
CLO3	To evaluate the process like membrane filtration, ion-exchange for application of treatment of wastewater.	L-5
CLO4	To analyze the advanced oxidation process for treatment of wastewater.	L-4

L1- Remember, L2- Understand, L3- Apply, L4- Analyze, L5- Evaluate, L6- Create

Mapping of CLOs with POs & PSOs

	Program Outcomes (POs)												Program Specific Outcomes (PSOs)		
Course Learning Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CLO1	H	M	M				M		M				H	M	
CLO2	H	M	M			M	M		M				H	M	
CLO3	M	M	M			M	M						M	M	
CLO4	M	M	M			M	M						M	M	

H: High, M: Medium, L: Low