



GUJARAT TECHNOLOGICAL UNIVERSITY

Bachelor of Engineering

Subject Code: 3171309

Semester – VII

Subject Name: ADVANCED WASTEWATER TREATMENT TECHNOLOGIES

Type of course: Professional Elective Course

Prerequisite: Knowledge of Physico-chemical and biological treatment of wastewater

Rationale: Satisfying the stringent standards for disposal of treated effluents in various sinks and reusing/recycling of treated effluents for different uses requires that the wastewater be given more exhaustive and advanced treatment. Hence this subject aims to give knowledge to the students regarding advanced wastewater treatment technologies.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

Content:

Sr. No.	Content	Total Hrs
1	Overview of Advanced Waste Water Treatment Introduction, Need of Advanced Waste Water Treatment, Purpose of Advanced Waste Water Treatment	02
2	Nutrient Removal – Nitrogen & Phosphorus Nitrogen Removal: .Nitrification , Denitrification Simultaneous nitrification and denitrification Phosphorus Removal : Introduction, Phosphorus removal by Chemical Precipitation: Principles of process, Chemicals applied, Chemistry of phosphorus precipitation, Process configuration, Phosphorus removal by Biological Precipitation: Principles of the process, Microorganisms involved in the process, Process configurations	06
3	Membrane Filtration Membrane Process Terminology 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: Microfiltration , Ultrafiltration , Nanofiltration, Reverse Osmosis	06
4	Membrane Bioreactor: Introduction, Working principle of MBR, comparison with Activated Sludge Process Types of MBR Processes, Membrane modules and materials, operating parameters of MBR, mechanisms of membrane fouling, Factors affecting membrane fouling, Membrane Fouling Prevention Techniques, Applications of MBR.	05



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5	Electrochemical Wastewater Treatment Processes Introduction • Electro-coagulation : Working principle of electro coagulation, Electrode materials and reaction chemistry, Factors affecting Electro coagulation, Reactor configurations, Applications • Electro-floatation : Working principle of electro floatation, Factors affecting electro floatation, Applications • Electro-oxidation : working principle of Electro oxidation processes, Electrode materials and reaction chemistry, Factors affecting Electro oxidation processes, Applications	06
6	Advanced Oxidation Processes Working principle of advanced oxidation processes, Types of oxidizing agents and its reaction chemistry, ozone based and non ozone based processes , Fenton and photo-Fenton Oxidation, Solar Photo Catalytic Treatment Systems	06
7	Adsorption Introduction, Fundamentals of adsorption, Type of adsorbents Development of adsorption isotherms: Freundlich , Langmuir, BET Activated carbon adsorption, Granular carbon adsorption Regeneration/reactivation of adsorbents	06
8	Ion Exchange: Introduction of Ion Exchange, Types of Ion Exchange Resins and its reaction chemistry, reactivation of Ion Exchange resins, Applications : Removal and recovery of heavy metals , Removal of nitrogen , Removal of phosphorus , Organic chemical removal	05

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
10	25	25	25	15	0

Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate and above Levels (Revised Bloom's Taxonomy)

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Waste water Engineering: Treatment and Disposal by Metcalf & Eddy
2. Membrane Systems for Wastewater Treatment –Water Environment Federation
3. Membrane Separation Processes by Kaushik Nath
4. Water Treatment Principles and Design by R. Rhodes Trussell Ph.D., P.E., BCEE, NAE, John C. Crittenden Ph.D., P.E., BCEE, NAE, David W. Hand Ph.D., BCEEM, Kerry J. Howe Ph.D., P.E., BCEE
5. Fundamentals of Water Treatment Unit Processes by David Hendricks.
6. Principles of Water Treatment by Kerry J. Howe, Ph.D., P.E., BCEE David W. Hand, Ph.D., BCEEM, John C. Crittenden, Ph.D., P.E., BCEE, NAE, R. Rhodes Trussell, Ph.D., P.E., BCEE, NAE, George Tchobanoglous, Ph.D., P.E., NAE



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Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Discuss methods of advanced treatment technologies for pollutant removal particularly nitrogen & phosphorous from wastewater.	20
CO-2	Compare the most appropriate types of membrane processes for advanced treatment of wastewater.	25
CO-3	Recommend advanced oxidation processes and electrochemical processes to treat concentrated wastewater.	30
CO-4	Explain the concept of advance treatment processes like adsorption, ion exchange for removal of pollutants.	25

List of Practicals:

1. Performance evaluation of Membrane Filter.
2. Nitrate removal using Ion-Exchange.
3. Fluoride removal using Adsorption Process.
4. Colour removal using Electro coagulation
5. COD removal using Electro coagulation.
6. COD and color removal from industrial wastewater using AOPs.