GUJARAT TECHNOLOGICAL UNIVERSITY

ENVIRONMENTAL ENGINEERING (13)
ADVANCED WASTEWATER TREATMENT TECHNOLOGIES
SUBJECT CODE: 2181308
B.E. 8TH SEMESTER

Type of course: Applied Science

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
				Theory Marks			Practical Marks			
L	T	P	C	ESE (E)	PA (M)		ESE (V)		PA (I)	
					PA	ALA	ESE	OEP		
4	2	0	6	70	20	10	30	0	20	150

Content:

Sr. No.	Content	Total Hrs	% Weightage
1	Overview of Advanced Waste Water Treatment Introduction, Need of Advanced Waste Water Treatment, Purpose of Advanced Waste Water Treatment	**2**	4
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	**12**	19
3	Adsorption Introduction, Fundamentals of adsorption, Type of adsorbents Development of adsorption isotherms: Freundlich , Langmuir, BET Activated carbon adsorption, Granular carbon adsorption	**8**	12
4	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 ,	**12**	19

	Nanofiltration, Reverse Osmosis		
5	Membrane Bio Reactor Introduction MBR Process Description : Membrane Bioreactor with Membrane Module Submerged in the Bioreactor, Membrane Bioreactor with Membrane Module Situated Outside the Bioreactor MBR System Features Membrane Module Design Considerations Process Applications : Industrial Wastewater Treatment, Municipal Wastewater	**8**	12
6.	Ion Exchange Fundamentals of Ion Exchange Types of Ion Exchange Resins Theory of Ion Exchange Applications : Removal and recovery of heavy metals , Removal of nitrogen , Removal of phosphorus , Organic chemical removal	**8**	12
7	Electrochemical Wastewater Treatment Processes Introduction Electro-coagulation : Factors affecting Electrocoagulation, Electrode materials , Reactor configurations Electro-floatation : Factors affecting electro floatation Comparison with other technology, Reactor configurations Electro-oxidation : Electro oxidation process, Reactor configurations	**6**	10
8	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	**8**	12

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. Environmental Engineering- Peary, Rowe & Tclobaloglous
3. Membrane Systems for Wastewater Treatment –Water Environment Federation
4. Membrane Separation Processes by Kaushik Nath

Course Outcome:

After learning the course the students shall be able to:

1. Apply advanced technologies in Wastewater treatment.
2. Select the most appropriates types of membrane processes for tertiary treatment of wastewater.
3. Apply advanced oxidation processes to treat concentrated non biodegradable wastewater.
4. Apply tertiary treatment processes like adsorption, ion exchange for optimum removal of pollutants.

List of Tutorials:

1. Numericals based on Adsorption isotherms
2. Assignment on membrane process
3. Assignment on Ion Exchange process.
4. Assignment on Advanced Oxidation Process.
5. Assignment on Advanced Wastewater Treatment for removal of Nitrogen & Phosphorus.
6. Assignment on Membrane Bioreactor.

ACTIVE LEARNING ASSIGNMENTS: Preparation of power-point slides, which include videos, animations, pictures, graphics for better understanding theory and practical work – The faculty will allocate chapters/ parts of chapters to groups of students so that the entire syllabus to be covered. The power-point slides should be put up on the web-site of the College/ Institute, along with the names of the students of the group, the name of the faculty, Department and College on the first slide. The best three works should submit to GTU.