



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Bachelor of Engineering

Level: UG

Branch: Environmental Engineering

Subject Code: BE05013011

Subject Name: Physico-Chemical Treatment Technologies

w. e. f. Academic Year:	2024-25
Semester:	5
Category of the Course:	Professional Core Course

Prerequisite:	Knowledge of subjects Fundamentals of Water Quality and Fundamentals of Waste water Quality
Rationale:	To learn the principles and theories behind the treatment of water and wastewater by physical and chemical processes.

Course Outcomes:

Sr. No.	CO statement	Marks% weightage
CO-1	Plan water and wastewater parameter with type of treatment required.	10
CO-2	Discuss purpose and theory of preliminary treatment of water and wastewater.	10
CO-3	Apply concepts of Coagulation, flocculation and Sedimentation processes with its parameters for treatment.	45
CO-4	Describe application of Filtration and Disinfection in water and wastewater treatment.	25
CO-5	Explain the physico-chemical sludge treatment and disposal methods.	10

Teaching and Examination Scheme:

Teaching / Learning Scheme (in Hours per semester)					Total Credits	Assessment Pattern and Marks					Total Marks
L	T	P	SL	Total no of hours per semester		Theory		Tutorial / Practical			
						ESE (E)	PA / CA (M)	PA/CA (I)	TW/SL (I)	ESE (V)	
45	0	30	45	120	4	70	30	20	30	50	200

Content:

Sr. No.	Content	Total Hrs
1	Introduction: Classification of treatment systems: Primary, secondary, Tertiary, Advanced; Physical, Chemical, Biological; Objectives and selection criteria of treatment methods; Characteristics of water and wastewater, types of treatment, conventional water and wastewater treatment, Conceptual differences in water and wastewater treatment.	05



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2	Preliminary treatment of water and wastewaters: Screens, purposes, types of screens and headloss in screens; Grit chambers: purposes and types of grit chambers. Flow equalization, mixing, aeration, and gas transfer.	05
3	Primary Treatment of water and wastewater: I. Coagulation and Flocculation: Colloid characteristics, Colloidal stability and Zeta potential, destabilization of colloids, Mechanisms of coagulation, types of coagulants and their chemistry, Rapid mixers and power requirement; Jar test procedure for optimum dose of coagulant and interpretation Flocculation: Types of flocculation, Flocculation kinetics and design parameters, types of flocculators, power requirement II. Sedimentation: Purpose, Types of settling phenomena, Newton's and Stoke's law for discrete settling, use of excel solver for calculating settling velocity, Analysis of discrete settling, flocculant settling, zone settling and compression settling, Zones of Sedimentation tank, Types of sedimentation tanks, design parameters, tube settlers	20
4	Primary Treatment of water and wastewater: I Filtration: Purpose, Mechanisms of filtration, Classification of filtration systems, different types of filters, Construction and Working of Slow sand and Rapid sand filters, hydraulics of filtration II Disinfection: Purpose, Characteristics of ideal disinfectant, Disinfection methods and mechanisms, Factors affecting disinfection, Disinfection with chlorine, Chlorine chemistry and breakpoint chlorination, types of chlorination, Disinfection using ozone and ultraviolet radiation	10
5	Sludge dewatering, treatment and disposal: Sources and composition of sludge; estimation of bulk density of sludge, need and methods of chemical conditioning, Principles and methods of Thickening: Gravity Thickeners Centrifuge, Belt press filter, Principles and methods of Dewatering: Sludge drying bed, filter press, vacuum filters	5
TOTAL		45

Suggested Specification table with Marks (Theory): (For B.E. only)

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
20	40	30	10	00	00



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R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create 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.

The syllabus of Physico chemical Treatment Technologies directly contributes to

SDG 3	Good health and well-being: This subject deals with water treatment technologies which ensure good quality water leading to good health and well-being of people.
SDG 6	Clean Water and Sanitation: This subject deals with water treatment technologies which ensure good quality water. Also, technologies for treatment of wastewater are covered.
SDG 9	Industry, Innovation and infrastructure: Knowledge of Physico chemical treatment processes to treat industrial wastewater is given.
SDG 14	Life below water: Prevention of water pollution due to human activities is achieved leading to protection of life in water bodies.

Reference Books:

1. Water Supply & Sewage Systems by McGhee (5th Edition-McGraw-Hill Kogakusha Ltd.)
2. Waste water Engineering Treatment & Reuse by Metcalf and Eddy (4th Edition – Tata McGraw-Hill Publishing Company Ltd.)
3. Environmental Engineering by Peavy and Rowe
4. Environmental Engineering by Mckenzie Davis and Cornwell (3rd Edition-published by WCB McGraw Hill)
5. Wastewater Treatment for Pollution Control by Soli J Arceivala (2nd Edition- Tata McGraw-Hill Publishing Company Ltd.)

List of Experiments:

1. Determination of optimum coagulant dose using multiple Jar Test Apparatus.
2. Determination of effect of coagulant dose on pH and alkalinity of water.
3. Determination of Residual Chlorine in drinking water.

Major Equipment:

Hot air oven, Jar Test Apparatus, pH meter, Turbidity meter, analytical weigh balance

List of Open-Source Software/learning website:

NPTEL Website, V-lab



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List of suggested activities for Term Work / Self Learning:

Sr No	PBL category	Name of activity	No of hours	Evaluation criteria
1	Seminar	Seminar on given syllabus topics	Duration=5 hrs	Based on content and presentation skills
2	Mini Project	Complex Problem-Solving targeting relevant SDGs	Duration = 10 hrs	Based on work done and report submitted
3	Micro project	Micro project	Duration=5 hrs	Based on work done and report submitted
4	Poster/ Chart Preparation	Poster Presentation / Infographic – Prepare a poster showing different parameters and their sources and effects	Duration=2 hrs	Based on poster/chart preparation and presentation skills
5	Video Based Learning	Technical Video based learning related to : Screens and grit chamber Types of mixers Tube /Plate settler Rapid sand filters/Pressure sand filters/Dual media filters Chlorinators	Duration of video: 10 hrs	Multiple choice questions-based Assessment
6	Industry Visit	Visit to a Water Treatment plant and prepare a visit report.	Visit = 5hrs, Report preparation = 3hrs Total = 8hrs	Based on the report submitted. The report should contain the details of treatment units including dimensions
7	PowerPoint presentation	PowerPoint Presentations on Subject related Advanced Technical Topics	Duration=5 hrs	Assessed based on creativity, clarity, and presentation skills
