GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Environmental Engineering

Subject Code : DI04013011

Subject Name : Physico Chemical Treatment of Water & Wastewater

w. e. f. Academic Year:	2025-26
Semester:	4th
Category of the Course:	PCC

Prerequisite:	Knowledge of course like Water supply and Sewarage system, Environmental chemistry
Rationale:	Environmental challenges are increasingly impacting the life of community at large, particularly due to water quality & waste water related problems. The course aims to prepare students to develop understanding and maintain quality of water & waste water by testing, analysis, treatment &monitoring to keep the environment and community healthy & safe.

Course Outcome:

After Completion of the Course, Student will able to:

No	Course Outcomes	RBT Level
01	Describe process for examination of water for removal of various impurities like suspended particles and oil & grease	R,U,A
02	Design of sedimentation tank for treatment plant	R,U,A
03	Identify various types of filters used in water treatment	R,U,A
04	Identify methods of softening, desalination and disinfection for water	R,U,A
05	Select appropriate method of sludge disposal	R,U,A

**Revised Bloom's Taxonomy (RBT)*

Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
				Theory		Tutorial / Practical		
L	T	PR	C	ESE(E)	PA(M)	PA(I)	ESE (V)	
3	0	2	4	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1. **Examination of water/wastewater and process of screening and skimming**	1.1 Characteristics and Examination of water and wastewater and variation in flow 1.2 Standards of quality of treated water and wastewater and types of impurity like suspended, dissolved and colloidal impurities 1.3 Purpose of screenings, skimming, flotation and flow equalization 1.4 Types of bar racks and screens 1.5 Working of skimming tank 1.6 Disposal of screenings 1.7 Types of flotation: Dissolved and dispersed 1.8 Types of equalization: In line and off line	9	20
2. **Sedimentation**	2.1 Principles of Sedimentation and Stokes' law applied to fluids 2.2 Types of particle settling 2.3 Classification of sedimentation tanks on basis of shape and flow 2.4 Factors influencing sedimentation 2.5 Deciding size of sedimentation tank 2.6 Coagulation and flocculation – purpose, principle 2.7 Types of coagulation and Determination of optimum coagulation dose.	9	20
3. **Filtration**	3.1 Theory of filtration, Uniformity coefficient and effective size 3.2 Type of filters -Slow sand filter, rapid sand filter, depth filters, pressure sand filter 3.3 Filter clogging, Turbidity breakthrough and Filter backwash 3.4 Advances in filtration	9	20
4. **Softening Desalination& Disinfection**	Types of hardness and its effects. 4.2 Methods of softening - Zeolite, lye, lime-soda, Ion- exchange method etc. 4.3 Methods of removal of dissolved solids - solar distillation gadgets and plants, direct freezing, reverse osmosis, electrolysis 4.4 Methods of disinfection	12	30

	-chlorination – chlorine dose, chlorine demand, residual chlorine, breakpoint chlorination 4.5 Color removal methods 4.6 Advanced Oxidation process like photo catalytic treatment, Fenton and ozone catalytic treatment, Introduction to Sono hybrid waste water treatment and its types		
5. Sludge Dewatering and Disposal	5.1 Sources of sludge 5.2 Estimation of bulk density of sludge 5.3 Methods of dewatering and thickening of sludge 5.4 Elutriation of sludge	6	10
	Total	**45**	**100**

Suggested Specification Table with Marks (Theory):

Distribution of Theory Marks (in %)					
R Level	**U Level**	**A Level**	**N Level**	**E Level**	**C Level**
35	**45**	**20**	**-**	**-**	**-**

Where R: Remember; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create (as per Revised Bloom's Taxonomy)

References/Suggested Learning Resources:

(a) Books:

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Wastewater Engineering, Treatment, Disposal,Reuse	Metcalf and Eddy	McGraw Hill InternationalEdition.
2	Water supply and Sewerage.	E W Steel and Terence J McGhee	McGraw Hill Book Company
3	Physical–chemical treatment of water and wastewater	Arcadio P. Sincero, Gregoria A. Sincero	CRC Press
4	Water Supply and Sanitary Engg	G S Birdi	Dhanpatraj and Sons
5	Standard Methods	_	APHA/ IS
6	Handbook of Water and Wastewater Analysis	Kanwaljit Kaur	Atlantic Publishers and Distributors
7	Relevant BIS Codes	_	Bureau of IndianStandards

(b) Open source software and website:

1. www.gpcb.gov.in
2. www.gwssb.org
3. www.cpcb.nic.in
4. www.neeri.res.in
5. www.Nptel.ac.in

Suggested Course Practical List:

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	To determine the pH and alkalinity of a given water sample	I	02
2	To determine the acidity of a given water sample	I	02
3	To determine the chloride content of a given water sample	I	02
4	To determine the Oil and grease content of a given water sample	I	02
5	To determine the total solids of a given sample of water	I	02
6	To determine the turbidity of the given water sample	I	02
7	Demonstrate screening and skimming process by different types of screens and draw their sketches	I	02
8	Study of removal of suspended particulate matter by Sedimentation and Determination of optimum dose of coagulant by jar test	I	02
9	To determine the color removal efficiency using spectrophotometer	II	02
10	Demonstrate functioning of various types of filters for water and wastewater	III	02
11	To determine the hardness of the given water samples	IV	02
12	Demonstrate process of Disinfection and To determine the residual chlorine of given water sample	IV	02
13	Demonstrate process of Desalination	IV	02
14	Determine Sludge volume Index	V	02
15	Prepare a report of site visit to a Treatment Plant	ALL	02
			Total:30

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	• **Sampling containers** • **Refrigerator**	1 to 15

S. No.	Equipment Name with Broad Specifications	PrO. No.
	• Magnetic stirrer • UV Spectrophotometer • Flame photometer • PH meter • Distillation Assembly • Turbidity meter • TDS meter • Chemical testing glasswares • Jar test apparatus • Hot air oven • GC-MS / HPLC (demo basis) • TOC Analyzer • Stereo/compound microscope.	

Suggested Project List:

a) Prepare list of Environmental rules and Acts prevalent in India
b) Prepare a chart depicting general standards for discharge of effluents into various sinks like Inland surface water, Public sewer, Land for irrigation and marine disposal
c) Prepare a chart depicting water quality criteria and designated best uses prescribed by CPCB
d) Prepare a chart depicting potable water quality standards prevalent in India
e) Prepare a chart depicting various treatment units for removal of suspended solids of large size
f) Prepare a chart depicting various treatment units for removal of oil and grease
g) Prepare a working model of tube settler for removal of suspended solids
h) Prepare a working model of rapid sand filter
i) Prepare a working model for removal of color from waste water
j) Prepare a working model for any one Advance Oxidation process
k) Identification of pesticides, VOCs, hydrocarbons using demo or Industry supported Lab
l) Basic micro plastic detection in water using stereo/compound microscope.

Suggested Activities for Students:

a) Explore internet for different water treatment processes being used to treat fresh and waste water and prepare report based on these.
b) Prepare Charts/Models for different water treatment processes.

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