

**GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT**  
**COURSE CURRICULUM**  
**COURSE TITLE: PHYSICO CHEMICAL TREATMENT OF WATER & WASTE**  
**WATER**  
**(COURSE CODE: 3351302)**

<b>Diploma Programme in which this course is offered</b>	<b>Semester in which offered</b>
Environmental Engineering	5 <sup>th</sup> Semester

### 1. 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. This course on treatment of water and waste water is an essential course for diploma programme in Environmental Engineering. As environmental technicians/engineers they should develop certain abilities relating to testing, treatment of water & waste water. As Environmental Engineers they should also be conversant with the sedimentation, coagulation, filtration and disinfection of water and waste water. They should also be conversant with denaturing and disposal of sludge. This course attempts to develop all of these abilities in pass outs.

### 2. LIST OF COMPETENCY:

The course content should be taught and with the aim to develop required skills in students so that they are able to acquire following competencies.

- **Estimate the quantity of water required for domestic and industrial uses and waste water generated by domestic and industrial use.**
- **Supervise operation and maintenance of the fresh water and waste water treatment plants.**

### 3. COURSE OUTCOMES

The theory should be taught and practical should be carried out in such a manner that students are able to acquire required learning out comes in cognitive, psychomotor and affective domain to demonstrate following course outcomes.

- i. Estimate water for domestic and industrial requirement
- ii. Explain the characteristics of water and waste water.
- iii. Determine the quality of generated sludge by treatment of water and waste water and various methods for disposal of sludge
- iv. Explain methods of disinfection, chlorination – chlorine dose, chlorine demand,
- v. Describe process for removal of oil, grease etc & disposal of skimming
- vi. Supervise sludge dewatering and disposal process.

vii. Operate and maintain the sedimentation plant

#### 4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Schedule				
				Theory Marks		Practical Marks		Total Marks
L	T	P	C	ESE	PA	ESE	PA	
4	2	2	8	70	30	20	30	150

**Legends:** L - Lecture; T - Tutorial/Teacher Guided Student Activity; P - Practical; C - Credit; ESE - End Semester Examination; PA - Progressive Assessment

#### 5. COURSE CONTENT DETAILS

Unit	Major Learning Outcomes (in cognitive domain)	Topics And Subtopics
<b>UNIT –I Quality , Quantity of Water and Waste Water</b>	1a. Understand quality of water and know potable water and treated water quality standards 1b. Describe characteristics of water and examination of water 1c. List the standards of potable water quality 1d. Explain spectrum of particulate size distribution with sketches 1e. Describe variation in water flow and the steps to estimate -water for domestic and industrial requirement -waste water quantity, gas flow	1.1 Quality of water and wastewater 1.2 Wholesome water 1.3 Impurity of water 1.4 Characteristics of water 1.5 Examination of water 1.6 Standards of potable water quality 1.7 Characteristics of sewage 1.8 Examination of sewage 1.9 Standards of quality of treated water and wastewater 2.1 Quantity of water and waste water 2.2 Waste water and gas flow 2.3 Water requirement for domestic and industrial purposes 2.4 Waste water formation and estimation 2.5 Spectrum of particulate size distribution 2.6 Variation of flows
<b>UNIT-II Screening and Skimming</b>	2a. Describe purpose of screening, skimming, flotation and equalization. 2b. Explain types of screens and terms related to screening and skimming 2c. Describe removal of oil, grease etc & disposal of skimming	3.1 Purpose of screenings and terms : blinding, stratification , contamination (oversize , fines, foreign body), gradation, grading, 3.2 Flow equalization 3.3 Types of bar racks and screens 3.4 Disposal of screenings 3.5 Removal of oil, grease etc. 3.6 Flotation 3.7 Skimming tank 3.8 Disposal of skimming

<p><b>UNIT-III Sedimentation</b></p>	<p>3a. Classify sedimentation tanks for water and waste water                  3b. List the characteristics of the settleable solids                  3c. List the factors influencing &amp; deciding size sedimentation tank for water and wastewater                  3d. Describe sedimentation                  3e. explain terms related to sedimentation                  3f. List the types of coagulants and their suitability                  3g. Describe coagulation , Flocculation unit operations                  3h. Define terms related to coagulation and flocculation.                  3i. Describe the feeding of coagulant and working of feeding devices                  3j. Describe the design criteria of flocculator, clarifiers.                  3k. Explain flocculation                  3l. List the types of clarifiers                  3m. Describe method of grit removal &amp; measuring settling efficiency of particles in clarifiers</p>	<p><b>SEDIMENTATION</b>                  4.1 Introduction                  4.2 Principles of Sedimentation and Stokes’ law applied to fluids                  4.3 Characteristics of the settleable solids                  4.4 Classification of sedimentation tanks for water and waste water                  4.5 Factors influencing sedimentation                  4.6 Deciding size of sedimentation tank for water and wastewater                  4.7 Standard design loading                  4.8 Detention period                  4.9 Coagulation – purpose, principle                  4.10 Types of coagulants and its suitability                  4.11 Determination of optimum coagulation dose.                  4.12 Feeding of coagulant and feeding devices                  4.13 Flocculation and flocculation tanks and design criteria of flocculator                  4.14 Clarifiers, its types and design criteria.                  4.15 Settling efficiency of particles                  4.16 Grit removal</p>
<p><b>UNIT-IV Filtration</b></p>	<p>4a. Describe filtration                  4b. List the types of filters                  4c. explain terms related to filtration                  4d. Explain with the remedies Filter clogging , Filter washing and Break through                  4e. State Advances in filtration</p>	<p>4.1. Theory of filtration                  4.2. Mechanism for particle size                  4.3. Hydraulics of filters                  4.4. Types of filters and their flow direction                  4.5. Filter clogging                  4.6. Filter washing                  4.7. Break through                  4.8. Deciding size of filter unit                  4.9. Advances in filtration</p>

<b>UNIT-V Softening Desalination &amp; Disinfection</b>	5a. Describe softening 5b. Explain methods of softening 5c. Describe desalination 5d. Explain methods of desalination 5e. Describe disinfection 5f. Explain methods of disinfection chlorination – chlorine dose, Chlorine demand, 5g. Describe application of chlorine 5h. Describe methods of removal of dissolved solids viz - Solar distillation gadgets and plants, -Direct freezing, - Reverse osmosis, - Electrolysis 5i. Describe removal of colour	5.1. Chemical precipitation 5.2. Water and wastewater softening 5.3. Estimation of dose of chemical 5.4. Methods of softening - ammonia, borax, lye, lime-soda, chelating, Ion- exchange method etc. 5.5. Methods of removal of dissolved solids - solar distillation gadgets and plants, direct freezing, reverse osmosis, electrolysis 5.6. Methods of disinfection -chlorination – chlorine dose, chlorine demand, application of chlorine 5.7. Use of various forms of chlorine, break through chlorination 5.8. Removal of colour
<b>UNIT-VI Sludge Dewatering and Disposal</b>	4.1. Know sources of sludge 4.2. List the steps to Estimate the rate of filtration 4.3. Describe principles of dewatering 4.4. Explain methods of dewatering 4.5. Describe thickening, lagging Elutriation of sludge 4.6. Explain chemical conditioning , vacuum and pressure filtration	6.1. Sources of sludge 6.2. Estimation of bulk density of sludge 6.3. Estimation of rate of filtration 6.4. Principles of dewatering 6.5. Methods of dewatering and suitability 6.6. Thickening of sludge 6.7. Chemical conditioning 6.8. Elutriation of sludge 6.9. Vacuum and pressure filtration 6.10. Sludge lagging

## 6. SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS ( Theory)

Unit	Unit Title	Teaching Hours	Distribution Of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Quality , Quantity of Water and Wastewater	10	4	3	5	12
II	Screening and Skimming	7	3	3	3	9
III	Sedimentation	10	4	4	4	12
IV	Filtration	6	2	3	3	8
V	Softening, Desalination and Disinfection	14	5	5	8	18
VI	Sludge De-watering and Disposal	9	3	3	5	11
	<b>TOTAL</b>	<b>56</b>	<b>21</b>	<b>21</b>	<b>28</b>	<b>70</b>

**Legends:** R = Remember; U = Understand; A = Apply and above levels (Bloom's revised 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.

## 7. SUGGESTED LIST OF EXERCISES/PRACTICAL

The practical/exercises should be properly designed and implemented with an attempt to develop different types of skills (**outcomes in psychomotor and affective domain**) so that students are able to acquire the competencies/programme outcomes. Following is the list of practical exercises for guidance.

*Note: Here only outcomes in psychomotor domain are listed as practical/exercises. However, if these practical/exercises are completed appropriately, they would also lead to development of certain outcomes in affective domain which would in turn lead to development of **Course Outcomes** related to affective domain. Thus over all development of **Programme Outcomes** (as given in a common list at the beginning of curriculum document for this programme) would be assured.*

*Faculty should refer to that common list and should ensure that students also acquire outcomes in affective domain which are required for overall achievement of Programme Outcomes/Course Outcomes.*

Sr. No.	Unit No.	PRACTICAL/EXERCISE (outcomes in psychomotor domain)	Approx. Hrs. Required
1	I	Test the Quality of Water & Wastewater - Demonstration of various tests related with physical properties of water and wastewater.	8
2	II	Demonstrate screening and skimming process by different types of screens and draw their sketches.	4
3	III	Demonstrate functioning of various types of filters for water and wastewater.	4
4	III	Demonstrate various methods of water softening.	4
5	IV	Demonstrate process of desalination.	4
6	IV	Demonstrate disinfections process of water and wastewater.	4
<b>TOTAL</b>			<b>28</b>

Sr. No.	Unit No.	List of Tutorial Exercises	Approx. Hrs. Required
1	I	Estimate the Quantity of Water & Wastewater: Tutorials based on estimation of quantity of water and waste water.	8
2	II	Screening And Skimming: Tutorials based on design.	6

3	II	Tutorial on Sedimentation.	4
4	III	Tutorial based on design of filters.	4
5	VI	Sludge Dewatering And Disposal: Tutorials based on estimation of generation of sludge and study of method of sludge disposal.	6
		<b>TOTAL</b>	<b>28</b>

### 8. SUGGESTED LIST OF STUDENT ACTIVITIES:

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

### 9. SPECIAL INSTRUCTIONAL STRATEGIES (If Any):

- i. Use video films/photographs/charts/Models to explain different water treatment processes.
- ii. Arrange field visit to civic and industrial water and waste water treatment facilities.
- iii. Arrange lecture of experienced water treatment engineers.
- iv. Ask students to collect samples of water from different places in the city and test them and report the quality to local authorities every year. Keep record to see how quality is changing over the years

### 10. SUGGESTED LEARNING RE3SOURCES

#### A. LIST OF BOOKS

Sr. No	Title Of Books	Author	Publication
1	Text book of Water supply and Sanitary Engg.	S K Hussain	Oxford And IBH
2	Water Supply and Sanitary Engg	G S Birdi	Dhanpatraj and Sons
3	A text book of Water Supply.	V N Gharpure	Allied Book House
4	A text book of Sanitary Engg.	V N Gharpure	Allied Book House
5	Water supply and Sanitary Engg.	Vazirani and Chandola	Khanna Publishers
6	Wastewater Engineering, Treatment, Disposal, Reuse	Metcalf and Eddy	McGraw Hill International Edition.
7	Water supply and Sewerage.	E W Steel and Terence J McGhee	McGraw Hill Book Company

**B. Major Equipment:**

- i. Testing Equipment for testing various quality of water
- ii. Models/Charts of different treatment processes.
- iii. Model/Charts of different treatment equipment

**C. List of Software and Learning Websites:**

- i. [www.gpcb.gov.in](http://www.gpcb.gov.in)
- ii. [www.gwssb.org](http://www.gwssb.org)
- iii. [www.cpcb.nic.in](http://www.cpcb.nic.in)
- iv. [www.neeri.res.in](http://www.neeri.res.in)
- v. [water.me.vccs.edu/courses/ENV115/lesson9.htm](http://water.me.vccs.edu/courses/ENV115/lesson9.htm)
- vi. [https://www.epa.ie/.../water/wastewater/EPA\\_water\\_treatment\\_manual\\_pr](https://www.epa.ie/.../water/wastewater/EPA_water_treatment_manual_pr)
- vii. [dcomm.cxc.lsu.edu/portfolios/08spr/spuroh1/.../processfinal.pd](http://dcomm.cxc.lsu.edu/portfolios/08spr/spuroh1/.../processfinal.pd)

**11. COURSE CURRICULAM DEVELOPMENT COMMITTEE.****Faculty Members from Polytechnics**

- **Prof .M.C. Sanandiya**, Lecturer in Environmental Engineering, K. J. Polytechnic, Bharuch,

**Coordinator and Faculty Members from NITTTR Bhopal**

- **Prof. V.H. Radhakrishnan**, Professor, Department of Civil and Environmental Engineering.
- **Prof. Shashi Kant Gupta**. Professor and Coordinator for State of Gujarat.