

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)**Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)**

Semester-VI

Course Title: Water Supply & Sanitary Engineering

(Course Code: 4360602)

Diploma program in which this course is offered	Semester in which offered
Civil Engineering	6 th Semester

1. RATIONALE

Water is very important element in civilization. Social life developed on the bank of Water-source. If society wants to make remarkable growth, the mental as well as social health play vital role. For that purpose, Pure, potable and palatable water to be supplied to the society and to maintain the hygiene of it, the used water must be collected and disposed of in nature by giving proper treatment, so the natural flora and fauna will not get affected by sewage disposal. In present time, solid waste also wants more attention. The technician must know about the quality as well as quantity of domestic water to be supplied to the society. Similarly, technician should be conversant with the collection, conveyance, treatment and disposal of waste water.

2. COMPETENCY

The course content should be taught and the curriculum should be implemented with the aim to develop different types of skills so that students are able to acquire following competency:

1. Selection of suitable treatment to raw water based on its quality useful for domestic purpose.
2. Maintain the efficiency of pipe-network for water supply and Sewage disposal effectively.

3. COURSE OUTCOMES (COs)

The theory should be taught and practical should be carried out in such a manner that students are able to acquire different learning out comes to demonstrate following course outcomes.

1. Understanding of importance of Water Supply and sanitary Engineering.
2. Calculate and Estimate the impurities present in water used for Domestic as well as construction works.
3. Laying and maintenance of water distribution system and sewer-networks.
4. Decide the requirement of treatment to make water potable and the treatment require for sewage to safely dispose off.
5. Effective implementation of house plumbing work.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T/2+P/2)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
			C	CA	ESE	CA	ESE	
3	-	2	5	30*	70	25	25	150

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate the integration of Cos, and the remaining 20 marks are the average of 2 tests to be taken during the semester for assessing the attainment of the cognitive domain UOs required for the attainment of the COs.

Legends: L-Lecture; T – Tutorial/Teacher Guided Theory Practice; P -Practical; C – Credit, CA - Continuous Assessment; ESE -End Semester Examination.

5. SUGGESTED PRACTICAL EXERCISES

The following practical outcomes (PrOs) are the sub-components of the Cos. Some of *the PrOs marked '*' are compulsory*, as they are crucial for that particular CO at the 'Precision Level' of Dave's Taxonomy related to 'Psychomotor Domain'.

No	Exercise	Hours
1.	Examples of prediction of future population by various methods. Examples of calculation of hardness of water for a given samples.	Home Assignment

2.	Sketches 1 Layout of Water treatment plant 2 Layout of Sewage treatment plant 3 Pipe Joints 4 Distribution System 5 Pipe fittings & sanitary fittings. 6 Activated sludge process 7 Trickling Filter 8 House Drainage Plan	Home Assignment
3.	Design:	02
	Design of septic tank (Student will be given data, I.S. 2470(II) and handouts on septic tank, and should be asked to design the septic tank.)	
4.	Laboratory Experiments	10
	1. Determine pH value of given water sample. 2. Determine turbidity of given water sample. 3. Determine Residual chlorine from given sample of water 4. Determine B.O.D. of wastewater sample. 5. Determine C.O.D. of wastewater sample.	
5.	Visits	08
	1. Water Treatment Plant 2. Sewage Treatment Plant 3. Maintenance work of water supply mains and sewage system Note: submit detailed report on visits carried out	
6.	Seminar	08
	The topic for the seminar should be given to the group of three to five students and they shall be asked to defend the seminar in presence of teacher and other students. Detailed report of seminar should be submitted at the end.	

Note

- i. More **Practical Exercises** can be designed and offered by the respective course teacher to develop the industry-relevant skills/outcomes to match the COs. The above table is only a suggestive list.
- ii. The following are some **sample** 'Process' and 'Product' related skills (more may be added/deleted depending on the course) that occur in the above-listed **Practical Exercises** of this course required which are embedded in the COs and ultimately the competency.

S. No.	Sample Performance Indicators for the PrOs.	Weightage in %
1	Initiative of students in collecting data and computation	20
2	Use of appropriate methods while work in team/group	20
3	Comprehension and presentation skills in drawing	20
4	Follow up standard steps for design calculations	20
5	Presentation of seminar and Timely submission	20
Total		100

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED

This major equipment with broad specifications for the PrOs is a guide to procure them by the administrators to usher in uniformity of practice in all institutions across the state.

S. No.	Equipment Name with Broad Specifications	PrO. No.
1	1. 2. Spectrophotometer 3. 4. Water Analysis Kit 5. B.O.D. Incubator Reflux apparatus Various model of Fitting and Fixtures	4

7. AFFECTIVE DOMAIN OUTCOMES

The following **sample** Affective Domain Outcomes (ADOs) are embedded in many of the abovementioned COs and PrOs. More could be added to fulfil the development of this competency.

- a) Work as a leader/a team member.
- b) Follow ethical practices.
- c) Practice environmentally friendly methods and processes. (Environment related)

The ADOs are best developed through the laboratory/field-based exercises. Moreover, the level of achievement of the ADOs according to Krathwohl's 'Affective Domain Taxonomy' should gradually increase as planned below:

- i. 'Valuing Level' in 1st year
- ii. 'Organization Level' in 2nd year.
- iii. 'Characterization Level' in 3rd year.

8. UNDERPINNING THEORY

Only the major Underpinning Theory is formulated as higher level UOs of *Revised Bloom's taxonomy* in order for the development of the COs and competency is not missed out by the students and teachers. If required, more such higher-level UOs could be included by the course teacher to focus on the attainment of COs and competency.

Unit	Major Learning Outcomes (Course Outcomes in Cognitive Domain according to NBA terminology)	Topics and Sub-topics
Unit-I Introduction	1.a <i>Discuss Importance of Water supply engineering</i> 1.b <i>Identify sources of water for potable use</i>	1.1 <i>Importance and necessity of water supply Engineering</i> 1.2 <i>Sources of water</i> 1.3 <i>Suitability of water</i> 1.4 <i>Choice of source</i>
Unit-II Quantity and Quality of Water	2.a <i>Calculate water demand for future population</i> 2.b <i>Enlist factor affecting water demand</i> 2.c <i>Determine various impurities found in water source</i>	2.1 <i>Types of demand</i> 2.2 <i>Population forecast</i> 2.3 <i>Computation of quantity of water</i> 2.4 <i>Fluctuation in demand</i> 2.5 <i>Factors affecting demand</i> 2.6 <i>Impurities in water</i> 2.7 <i>Collection of water sample</i> 2.8 <i>Physical Chemical and Biological tests</i> 2.9 <i>Standards of quality of water</i>

Unit-III Treatment of Water	3.a Discuss objectives of water Treatment 3.b Discuss principles used in water treatment. 3.c Discuss various units used for treatment of water	3.1 Objects of water treatment 3.2 Location of water treatment plant 3.3 Layout of water treatment plant 3.4 Basic principles of working of treatment plant 3.5 Functioning of Coagulation treatment plant
		3.6 Sedimentation 3.7 Filtration 3.8 Disinfection 3.9 Water Softening
Unit-IV Conveyance of Water	4.a Enlist various materials used for pipe 4.b Discuss various pipe joints in Distribution system 4.c Enlist different valves and fittings used in pipe network	4.1 Types of pipes used for conveyance 4.2 Pipe joints 4.3 Laying of Pipes 4.4 Distribution system 4.5 Types of valves 4.6 Types of Meters 4.7 Pipe fittings and fixtures
Unit-V Maintenance of Water Supply Mains	5.a Discuss necessity of maintenance of water supply mains	5.1 Necessity 5.2 Methods to prevent leaks 5.3 Measures for conservation of water
Unit-VI Sanitation System	6.a Discuss objectives of sewage disposal 6.b Discuss methods of sewage collection	6.1 Related terms 6.2 Objective of sewage disposal 6.3 Methods of sewage collection 6.4 Conservancy system 6.5 Water carriage system

<p>Unit-VII Drains and Sewers</p>	<p>7.a Discuss sewer appurtenances 7.b Discuss Testing and maintenance of sewer</p>	<p>7.1 Classification of Drains 7.2 Sewer section 7.3 Sewer joint 7.4 Manhole 7.5 Flushing tank 7.6 Catch basin 7.7 Laying of sewer 7.8 Appurtenances and its locations 7.9 Hydraulic testing of sewer pipe 7.10 Maintenance of sewer</p>
<p>Unit-VIII Sewage Treatment and Disposal</p>	<p>8.a Discuss Characteristics of sewage 8.b Discuss sewage treatment process</p>	<p>8.1 Characteristics of sewage 8.2 Sampling of sewage 8.3 Treatment of sewage</p>
	<p>8.c Explain methods of sewage disposal</p>	<p>8.4 B.O.D. Test, C.O.D. test 8.5 Methods of sewage disposal</p>
<p>Unit-IX House Plumbing</p>	<p>9.a Explain house plumbing system 9.b Discuss plumbing practice and safety precautions 9.c Enlist sanitary fittings used in house plumbing</p>	<p>9.1 Related terms 9.2 Plumbing tools 9.3 Pipes and pipe fittings 9.4 Fixing and jointing pipes and accessories 9.5 Traps 9.6 House drainage plant 9.7 Plumbing practice and operations 9.8 Safety and precautions 9.9 Sanitary fittings</p>

Unit-X Maintenance of Sewage System	10.a Explain procedure for maintenance of sewerage system 10.b Explain functions of maintenance equipments and tools	10.1 Procedure for maintenance of sewerage system 10.2 Causes of trouble and odor 10.3 Sewer cleaning operations 10.4 Requirements of maintenance 10.5 Functions of each maintenance equipments and tool 10.6 Selection of equipment for given maintenance job. 10.7 Explosives in sewers. 10.8 Safety measures for sewer-men
Unit-XI Recycling of Waste Water and Solid Waste	11.a Discuss different methods of recycling waste water 11.b Discuss management and utilization of solid waste generated from society	11.1 Different method with respect to quality of waste water 11.2 Utilization and management of solid waste

Note: The UOs need to be formulated at the 'Application Level' and above of Revised Bloom's Taxonomy' to accelerate the attainment of the COs and the competency.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction to Water Supply Engineering	2	1	1	0	4
II	Quantity and Quality of Water	4	1	1	2	7
III	Treatment of Water	7	1	2	4	12
IV	Conveyance of Water	5	2	2	1	9
V	Maintenance of Water Supply Means	2	1	1	0	4

VI	<i>Sanitation System</i>	3	2	1	0	5
VII	<i>Drains and Sewers</i>	4	1	2	1	7
VIII	<i>Sewage treatment and Disposal</i>	7	2	2	3	10
IX	<i>House Plumbing</i>	3	1	1	1	4
X	<i>Maintenance of Sewage System</i>	2	1	1	0	4
XI	<i>Recycling of Waste Water and Solid Waste</i>	3	1	1	1	4
	<i>Total:</i>	42	14	15	13	70

Legends: R=Remember, U=Understand, A=Apply and above (Revised Bloom's taxonomy)

Note: This specification table provides general guidelines to assist students in their learning and to teachers to teach and question paper designers/setters to formulate test items/questions to assess the attainment of the UOs. The actual distribution of marks at different taxonomy levels (of R, U, and A) in the question paper may vary slightly from above table.

10. SUGGESTED STUDENT ACTIVITIES

Other than the classroom and laboratory learning, following are the suggested studentrelated **co-curricular** activities which can be undertaken to accelerate the attainment of the various outcomes in this course: Students should conduct following activities in group and prepare reports of about 5 pages for each activity, also collect/record physical evidences for their (student's) portfolio which will be useful for their placement interviews:

- (a) Prepare a model of septic tank.
- (b) Prepare model of Water/ wastewater treatment plant.

11. SUGGESTED SPECIAL INSTRUCTIONAL STRATEGIES (if any)

These are sample strategies, which the teacher can use to accelerate the attainment of the various outcomes in this course:

- a) Massive open online courses (**MOOCs**) may be used to teach various topics/sub topics.
- b) Guide student(s) in undertaking micro-projects.
- c) '**L**' in **section No. 4** means different types of teaching methods that are to be employed by teachers to develop the outcomes.
- d) About **20% of the topics/sub-topics** which are relatively simpler or descriptive in nature is to be given to the students for **self-learning**, but to be assessed using different assessment methods.
- e) With respect to **section No.11**, teachers need to ensure to create opportunities and provisions for **co-curricular activities**.
- f) Guide students on how to address issues on environ and sustainability

- g) Expert lecture by practicing valuer on Valuation techniques, methods and criteria of any property.
- h) Expert lecture on latest software for Estimating and costing

12. SUGGESTED MICRO-PROJECTS

Only one micro-project is planned to be undertaken by a student that needs to be assigned to him/her in the beginning of the semester. In the first four semesters, the micro-project are group-based. However, in the fifth and sixth semesters, it should be preferably be **individually** undertaken to build up the skill and confidence in every student to become problem solver so that s/he contributes to the projects of the industry. In special situations where groups have to be formed for micro-projects, the number of students in the group should **not exceed three**.

The micro-project could be industry application based, internet-based, workshopbased, laboratory-based or field-based. Each micro-project should encompass two or more COs which are in fact, an integration of PrOs, UOs and ADOs. Each student will have to maintain dated work diary consisting of individual contribution in the project work and give a seminar presentation of it before submission. The total duration of the micro-project should not be less than **16 (sixteen) student engagement hours** during the course. The student ought to submit micro-project by the end of the semester to develop the industryoriented COs. A suggestive list of micro-projects is given here. This has to match the competency and the COs. Similar micro-projects could be added by the concerned course teacher:

- (a) Water quality analysis of given sample
- (b) Design of water treatment plant
- (c) sanitation survey of given building
- (d) Evaluation of present water distribution system of given area.
- (e) Evaluation of factory/industry sample with respect to dispose off in environment.
- (f) Study of water borne diseases in your area in last 20 years.
- (h) Solid waste management required for given site.

13. SUGGESTED LEARNING RESOURCES

Name of book	Author	Publisher
water supply & Sanitary Engg.	S.K.Hussain	Oxford & IBH
Elements of Public Health Engineering	K.N.Duggal	S.Chand & Co.
Water supply & Sanitary Engg.	Vazirani & Chandola	Khanna Publishers

A Text book of water supply & Sanitary Engg.	S.K.Garg	Khanna Publishers
Water supply & Sanitary Engineering	Birdie G.S.	Dhanpatrai & Sons
A Text book of water supply engineering	V.N. Gharpure	Allied Book Stall, Baroda
A Text book of sanitary engineering	V.N. Gharpure	Allied Book Stall, Baroda
Water pollution & Disposal of Waste Water on Land	U.N.Mahida	Tata McGraw Hill
Municipal and Rural Sanitation	Ehlers & Steel	Mc Graw hill book
Water and Waste water Engineering	Gorden ,Fair & Gayer Okun	John Willey & Sons

14. SOFTWARE/LEARNING WEBSITES

a) www.nptel.ac.in

15. PO-COMPETENCY-CO MAPPING

Semester VI	WATER SUPPLY & SANITARY ENGINEERING (Course Code:)									
	POs and PSOs									
Competency & Course Outcomes	PO 1 Basic & Discipline-specific knowledge	PO 2 Problem Analysis	PO 3 Design/development of solutions	PO 4 Engineering Tools, Experimentation & Testing	PO 5 Engineering practices for society, sustainability & environment	PO 6 Project Management	PO 7 Life-long learning	PSO 1	PSO 2	PSO 3 (If needed)
<u>Competency</u>	Impart knowledge about irrigation structures and irrigation systems in different phases.									
CO(1) Importance of Water Supply and sanitary Engineering. .	3	3	-	-	1	-	-			

CO(2) Calculate and Estimate the impurities present in water used for Domestic as well as construction works.	2	3	3	3	1	-	-			
CO(3) Laying and maintenance of water distribution system and sewer-networks	3	3	3	-	1	2	1			
CO(4) Decide the requirement of treatment to make water potable and the treatment require for sewage to safely dispose off.	3	3	3	3	2	-	2			
CO(5) Effective implementation of house plumbing work.	3	3	2	-	1	1	1			

Legend: '3' for high, '2' for medium, '1' for low or '-' for the relevant correlation of each competency, CO, with PO/ PSO

16. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

S. No.	Name and Designation	Institute	Contact No.	Email
1	Dr. D. H. Dalal	GPG Ahmedabad	9428858913	dhdalal@gmail.com
2	Shri A. K. Popat	RCTI, Ahmedabad	9825443501	anilkpopat@gmail.com