GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)

Competency-focused Outcome-based Green Curriculum-2022 (COGC-2022)
Semester-IV

Course Title: Water Supply and Sewerage System
(Course Code: 4341301)

Diploma programme in which this course is offered	Semester in which offered
Environmental Engineering	4th Semester

1. RATIONALE

Water is an integral component of our life and major constituent of our body and also planet earth. Water is available in various forms on earth's surface but it involves various mechanism to supply it to consumers and also to collect waste water generated. Therefore, Water supply and Sewerage system is an integral part of any environmental engineering project. However, if they are not well designed and maintained then it may lead to water contamination and other type of pollution. Therefore, knowledge and understanding of water supply and sewer system and to ensure quality in their construction is very important for engineers working at site to avoid water contamination and pollution in future. This course attempts to develop knowledge and skills for designing and execution of water and sewerage system and also imparts knowledge about water distribution and sewerage collection. Every environmental engineer should try to develop mastery over this course.

2. COMPETENCY

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

- **Design and execute water and sewerage system including their treatment plants for a medium size residential or commercial scheme.**

3. COURSE OUTCOMES (COs)

The practical exercises, the underpinning knowledge and the relevant soft skills associated with this competency are to be developed in the student to display the following COs:

a) Evaluate various sources of water in terms of quantity and quality.
b) Estimate the water demand considering future projection of population.
c) Explain the components of water supply scheme including pipe network, distribution systems, valves and fitting.
d) Estimate the quantity of sanitary and storm sewage.
e) Explain essential features of various types of sewers and sewer appurtenances.

4. TEACHING AND EXAMINATION SCHEME

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

(*): Out of 30 marks under the theory CA, 10 marks are for assessment of the micro-project to facilitate integration of COs and the remaining 20 marks is the average of 2 tests to be taken during

the semester for the 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'*.

S. No.	Practical Outcomes (PrOs)	Unit No.	Approx. Hrs. required
1	Study of sources of water and w/w andproblem based on this topic	I	02
2	Study the factors affecting quantity of water. Solve problems based on population forecasts and average precipitation run off	I	04
3	Study based on collection and conveyance of water and problems based on this	II	02
4	Solve problems based on water distribution system	III	02
5	Design water supply system in multi-story building	III	04
6	Design water supply system for a small housing society	III	04
7	Solve problem based on estimation of sewage quantity.	IV	02
8	Study of construction and maintenance of Sewers	V	02
9	Study and drawing of sewer appurtenance	VI	02
10	Design sewer system for a small housing society	V and VI	02
11	Design a drainage system for storm water	IV	02
			Total: 28

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 %
	For PrOs 1 to 11	
1	Identification of Problem statement and data given	10
2	Make necessary assumptions correctly	10
3	Use appropriate formulas to calculate values	40
4	Perform calculations accurately	20
5	Interpret results and their conclusions and prepare report	10
6	Submission for progressive assessment on time	10
7	Viva Voce	10
	Total	**100**

6. MAJOR EQUIPMENT/ INSTRUMENTS REQUIRED (Not Applicable)

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

S. No.	Equipment Name with Broad Specifications	PrO. No.
1		

7. AFFECTIVE DOMAIN OUTCOMES

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

a) Work as a team member/ individual.
b) Follow ethical practices.
c) Follow safe practice on site and in laboratory.
d) Practice of environmental friendly methods and processes.

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 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 attainment of COs and competency.

Unit	Unit Outcomes (UOs)	Topics and Sub-topics
Unit – I Sources 0f Water and its Demand	1a. Explain importance and necessity of water supplyscheme 1a.1 Define hydrology 1b. Discuss hydrology and generation of runoff 1c. Discuss various types of waterdemand 1d. Determine future population	1.1 Introduction 1.2 Sources of surface water (riverstreams, lakes, ponds) 1.3 Sources of sub surface (Springs, wells) 1.4 Ground water yield and itsmeasurements 1.5 Define hydrology, it's importance in generation ofrunoff. 1.6 Various types of water demand 1.7 Factor affecting per capital waterdemand. 1.8 Standard methods of forecasting population 1.8.1 Arithmetical increase method 1.8.2 Geometrical increase method 1.8.3 Incremental increase method 1.8.4 Decrease rate of growthmethod 1.8.5 Graphical Method
Unit-II Collection and Conveyance	2a. Describe various types ofintakes 2b. Explain various Joints in pipe network 2c. Explain hydraulic design of pressure pipe 2d. Discuss methods of laying ofpipes and sewer line	2.1 Types of intakes 2.2 Design of intakes 2.3 Conveyance of water 2.4 Different types of Joints in pipenetwork 2.5 Use of hydraulic design of pressurepipe 2.6 Compute losses of head in pipe 2.7 Methods of laying of pipes and sewer line, its tests for straightness,water tightness and smoke test.

Unit-III Water Distribution System	3a. Explain various types ofDistribution System 3b. Describe layout of DistributionSystem 3c. Discuss various types of distribution reservoir	3.1 Types of Distribution system 3.1.1 Gravity system. 3.1.2 Pumping system 3.1.3 Dual system 3.2 Layout of Distribution system 3.3 Requirement of a Distributionsystem 3.4 Method of supplying water. 3.5 Types of Distribution Reservoirs.

Unit	Major Learning Outcomes (in cognitive domain)	Topics and Sub-topics
Unit-IV Sewer System and Quantity of Sewage	4a. Explain the sewer disposalsystem 4b. Describe methods of sewagecollection 4c. Describe sources of sanitary sewage 4d. Determine quantity of sanitary sewage and storm water sewage	4.1 Aims and objectives of sewer disposal system 4.2 Types and Characteristics of Sewer Materials 4.3 State and classify systems of sanitation. 4.4 Methods of sewage collection withtheir merits and demerits 4.5 Sewage conveyance system 4.6 Patterns of collection of sewage. 4.7 Evaluate sources of sanitary sewage 4.8 Roll of infiltration in addition of sanitary sewage 4.9 State and explain subtractionallowances 4.10 Methods of determination ofquantity of sanitary sewage. 4.11 Variation in quantity of sewage 4.12 Methods of determination of quantity of storm water
Unit-V Construction And Maintenance Of Sewers	5a. Explain the method of laying of sewers 5b. Describe the necessity of maintenance of sewer	5.1 Importance of making centerline ofsewers and position of Sewer appurtenances. 5.2 Excavation, bracing and dewatering of trenches. 5.3 Method of laying of sewers 5.4 Jointing of sewers. 5.5 Methods of Hydraulic Testing of pipes and sewers, with specifications. 5.6 Necessity of maintenance of sewers. 5.7 Causes of damage to Sewers 5.8 Problems in sewer maintenance

Unit-VI Sewer Appurtenances	6.a Describe the various Appurtenances in a Distribution system 6.b. Comprehend design of Overflows and Regulators. 6.c. Explain the Ventilation Pipes.	6.1 Define "Appurtenances" and itsnecessity 6.2 For the operation and maintenanceof sewerage system various devices : 6.2.1 Manholes and Inspection Chambers 6.2.2 Hazards of Manhole Work 6.2.3 Drop manholes. 6.2.4 Lamp holes. 6.2.5 Street Inlets. 6.2.6 Flushing tanks. 6.2.7 Inverted siphon. 6.2.8 Storm water relief work 6.3 Design of Overflows and Regulators. 6.4 Ventilation Pipes.

9. SUGGESTED SPECIFICATION TABLE FOR QUESTION PAPER DESIGN

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A	Total Marks
I	Sources of Water and its Demand	3	2	3	4	09
II	Collection And Conveyance	3	3	4	2	09
III	Water Distribution System	5	3	5	3	11
IV	Sewer System and Quantity of Sewage	6	3	5	5	13
V	Construction And Maintenance of Sewers	5	3	6	4	13
VI	Sewer Appurtenances	6	5	7	3	15
Total		**28**	**19**	**30**	**21**	**70**

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

Note*: This specification table provides general guidelines to assist student for their learning and to teachers to teach and question paper designers/setters to formulate test items/questions 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 student-related ***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) Study the water distribution system of residing city and list its merits and demerits
b) Study the Sewage collection system of residing city and list its merits and demerits

c) Undertake micro-project.
d) Give seminar on any relevant topic.

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.10***, teachers need to ensure to create opportunities and provisions for ***co-curricular activities***.
f) Guide students on how to address issues on environment and sustainability

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 five.***

The micro-project could be industry application based, internet-based, workshop-based, 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 industry oriented 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:

i. Prepare a chart showing various sources of water.
ii. Study water supply scheme of a multistory complex or a small housing society. Prepare a report on it and discuss its merits and shortcomings.
iii. Study sewer system of a multistory complex or a small housing society and prepare a report on it and discuss its merits and shortcomings.
iv. Visit a nearby water treatment plant and prepare a report indicating the Methods adopted, its capacity, amount of different chemicals and energy used and the quality of water produced for domestic use.
v. Visit a nearby water treatment plant and evaluate the performance of water treatment plant as per the checklist provided by GWSSB (Gujarat water supply and sewerage board).
vi. Visit a nearby sewage treatment plant and prepare a report indicating the methods adopted, its capacity, amount of different chemicals and energy used.
vii. Visit a nearby sewage treatment plant and prepare a report indicating the

quality of water discharged in the environment.

viii. Prepare a list of IS related to Water Supply and Sanitary engineering.

ix. Prepare a report on odour control technologies available for sewerage system.

x. Prepare a chart depicting various Sewer Appurtenances.

13. SUGGESTED LEARNING RESOURCES

S. No.	Title of Book	Author	Publication with place, year and ISBN
1	Water supply and sanitary engineering	S.C. Rangwala	Charotar publication
2	Water supply and sanitary engineering	G.S. Birdie	Dhanpat rai publication
3	Water Supply Engineering	S.K.Garg	Khanna Publishers
4	SP-35(Handbook on Water Supply and Drainage (With Special Emphasis on Plumbing)	BIS	BIS
5	Manual on sewerage and sewage treatment systems	CPHEEO (Central Public Health and Environmental Engineering Organisation)	CPHEEO, New Delhi
6	Manual on water supply and treatment	CPHEEO (Central Public Health and Environmental Engineering Organisation)	CPHEEO, New Delhi

14. SOFTWARE/LEARNING WEBSITES

a) www.cpheeo.gov.in

b) www.nptel.ac.in

c) www.gpcb.gov.in

d) www.gwssb.org

e) www.cpcb.nic.in

f) www.neeri.res.in

15. PO-COMPETENCY-CO MAPPING

Semester IV	Water Supply and Sewerage System (Course Code:4341301)									
	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 Environmental planning & design	PSO 2 Environmental Impact Assessment	PSO 3 (If needed)
Competency	i. Design and execute water and sewerage system including their treatment plants for a medium size residential or commercial scheme.									
Course Outcomes CO1: Evaluate various sources of water in terms of quantity and quality.	3	3	-	3	3	-	2	3	3	-
CO2: Estimate the water demand considering future projection of population.	3	2	2	3	3	-	2	3	3	-
CO3: Explain the components of water supply scheme including pipe network, distribution systems, valves and fitting.	3	-	3	-	3	-	2	3	3	-
CO4: Estimate the quantity of sanitary and storm sewage.	3	-	3	3	3	-	2	3	3	-
CO5: Explain essential features of various types of sewers and sewer appurtenances.	3	-	3	-	3	-	2	3	3	-

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

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