

GUJARAT TECHNOLOGICAL UNIVERSITY (GTU)
Competency-focused Outcome-based Green Curriculum-2021 (COGC-2021)
Semester-VI
Course Title: Ground Water Engineering
(Course Code: 4360607)

Diploma programmer in which this course is offered	Semester in which offered
Civil Engineering	Six

1. RATIONALE:

Groundwater engineering, is a branch of engineering which is concerned with groundwater movement and design of wells, pumps, and drains. Including prevention of sea water intrusion. The main concerns in groundwater engineering include groundwater contamination, conservation of supplies, and water quality. Due to over exploitation and pollution of surface water, ground water is the only remaining source to satisfy different types of water demands. However, the ground water table is decreasing due to excess utilization and lack of recharging. In this scenario it is must for civil engineers working in the area of water resource management as well as all civilian to take measures to improve ground water recharging and avoid contamination. This course attempts to provide knowledge and skills for effective ground water management.

2. COMPETENCY

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

- Take steps to enhance ground water recharge and prevent its contamination

3. COURSE OUTCOMES (COs)

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

- Interpret different terms related to ground water and process of ground water survey.
- Find suitable method of artificial recharge of ground water for given conditions.
- Design a tube well for given condition.
- Interpret mechanism of sea water intrusion & controlling measures for sea water intrusion.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P/2)	Examination Scheme				
L	T	P		Theory Marks		Practical Marks		Total Marks
			C	CA	ESE	CA	ESE	
3	0	2	4	70	30	25	25	150

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

5. COURSE CONTENT

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics
UNIT-I Introduction	1.1 Explain the sources of Groundwater 1.2 Define various terms related to groundwater 1.3 Define various terms related to aquifer 1.4 Explain Aquifers 1.5 Define various terms related to permeability 1.6 Describe causes of changes in ground Water quantity	1.1 Sources of water 1.2 Groundwater scenario of Gujarat and India 1.3 Origin of Groundwater 1.4 Groundwater Characteristics 1.5 Terms related to Ground water Engineering - Hydraulic conductivity - Specific Retention - Transmissibility - Coefficient of transmissibility - Yield - Specific yield - Storage coefficient 1.5 Aquifer-Types of aquifer, aquiclude, aquifuge, porosity of aquifer. 1.6 Permeability- Darcy's permeability, coefficient of permeability 1.7 Causes of changes in ground water quantity

<p>UNIT-II</p> <p>Ground water - Survey and Quality</p>	<p>2.1 Describe various surface and subsurface surveys for ground water exploration</p> <p>2.2 Describe groundwater Quality parameters</p> <p>2.3 Describe reasons for ground Water quality degradation</p> <p>2.4 Explain steps for Improvement of Groundwater quality.</p>	<p>2.1 Surface Methods for ground water exploration</p> <p>Esoteric Methods</p> <ul style="list-style-type: none"> - Geomorphologic methods - Geological & structural Methods - Soil and Micro-Biological Methods - Remote Sensing Techniques - Surface Geophysical Methods <p>2.2 Sub surface methods for ground water exploration</p> <p>2.3 Geophysical survey of ground water - Surface Geophysical techniques</p> <ul style="list-style-type: none"> -Electric logging & Radioactive logging Method <p>2.4 Ground water quality</p> <ul style="list-style-type: none"> - Factors affecting ground water quality - Classification of ground water quality -Types of water quality -Physical characteristics of ground water quality -Various test for ground water quality
		<p>2.5 Parameters of ground water quality</p> <p>2.6 Groundwater quality degradation</p> <p>2.7 Reasons of groundwater quality degradation</p> <p>2.8 Effects of changes in ground water quality</p> <p>2.9 Importance of ground water quality</p>

<p>UNIT-III Artificial Recharge</p>	<p>3.1 Describe methods of Artificial recharging 3.2 Describe suitability of recharging methods 3.3 Explain Identification of areas for artificial recharge. 3.4 Explain Artificial recharge structures</p>	<p>3.1 Conceptual introduction -Ground water development 3.2 Stages of ground water development 3.3 Social, economical and overall national benefits of ground water development 3.4 Artificial Recharge-Objectives and Importance 3.5 Development of Artificial recharging 3.6 Methods of artificial recharge 3.7 Suitability , advantages and disadvantages of artificial recharge methods 3.8 Identification of areas for artificial recharge. 3.9 Artificial recharge structures 3.10 Rain water harvesting</p>
<p>UNIT-IV Wells and Tubewells</p>	<p>4.1 Differentiate between wells and tubewells 4.2 Describe well losses 4.3 Describe terms related 4.4 Explain method of construction of wells Design the wells</p>	<p>4.1 Introduction 4.2 Difference between wells and tubewell 4.3 Types of wells - Open wells - Tube wells - Shallow, deep and Medium well 4.4 Benefits of well and tube well irrigation 4.5 Well losses 4.5 Specific capacity 4.6 Interference among wells 4.7 Gravity well - Fully penetrating gravity wells - Partially penetrating gravity wells 4.8 Safe yield of well 4.9 Construction Method of wells 4.10 Selection of pump sets - Plunger pump - Jet pump - Submersible pump - Air lift pump</p>

		4.11 Design of Tube well -Steps, features -Structure -Size -Basis -Principles -Data required -Methods
UNIT-V Sea Water Intrusion	5.1 Explain causes of sea Water intrusion 5.2 Describe ill-effects of Sea water intrusion 5.3 Explain remedial measures to prevent sea water intrusion a. Explain with examples sea water intrusion	5.1 Introduction 5.2 Causes of sea water intrusion 5.3 Ill-effects of sea water intrusion 5.4 Mechanism of sea water intrusion 5.5 Ghyben -Herzberg fresh watersea water Interface 5.6 Remedial measures to control sea water intrusion a. Related examples

6 SUGGESTED SPECIFICATION TABLE WITH HOURS & MARKS(Theory)

Unit No.	Unit Title	Teaching Hours	Distribution of Theory Marks			
			R Level	U Level	A Level	Total Marks
I	Introduction	06	05	05	00	10
II	Ground water Survey and quality	08	06	04	04	14
III	Artificial Recharge	08	05	05	04	14
IV	Wells and Tubewells	12	04	04	10	18
V	Sea water Intrusion	08	04	04	06	14
Total		42	24	22	24	70

Legends: R = Remember , U = Understand , A= Apply and above Level (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 mainly 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	Approx. Hrs. Required
1		Drawings and Illustrations	08
	I.II.III.IV ,V	Prepare drawing of Sources of water, Representation of coefficient of storage of ground water Illustration of aquifers Various types of wells Various types of tubewells Artificial recharge structures Mechanism of Sea water intrusion Rain water harvesting	
2		Practical	04
	I	Determine the TDS, Electrical Conductivity (ES) of groundwater sample	
	II	Determine the pH and Hardness of groundwater sample	
3		Solve numerical from given data :	04
	IV	Examples related to well hydraulics	
	V	Examples related to sea water intrusion	
4		Field visit and Report :	08
	I	Visit to Water resources department/Irrigation department for collecting existing groundwater data of the district with respect to importance & necessity of ground water management.	
	II	Visit to various storage works and collect data pertaining to quality.	
	III	Visit to nearby rain water harvesting structure and prepare a report.	

5		Seminar :	04
	I to VII	Select a topic as a seminar and present it using modern teaching aids.	
Total Hours	28		

8 SUGGESTED LIST OF STUDENT ACTIVITIES

8.1 Prepare a model/prototype of groundwater recharging structure in the college/ suggested Premises.

8.2 Prepare a model/prototype of tube well in the suggested premises.

8.3 Explore internet to study different issues related to ground water level and Contamination and prepare a report.

8.4 Prepare a report on Remote Sensing Method for ground water Survey

8.5 Motivate owners of some building/housing society being constructed to install ground water recharging system and design system for them.

9 SPECIAL INSTRUCTIONAL STRATEGIES (If Any)

- Show video films of sea water intrusion and its effects
- Arrange expert lectures of Engineers working in ground water department/geological survey of India.
- Present case studies of success and failures of ground water recharge projects being carried out by some NGOs of national/state repute.

10 SUGGESTED LEARNING RESOURCES

A BOOKS

Sr. No.	Title	Author	Publisher
1	Groundwater Hydrology	Raghunath H. M	Willy Eastern Ltd-2000
2	Groundwater Hydrology	Todd D.K.	John Willey & Sons
3	Groundwater Engineering	Abdel-Aziz	Mc-graw Hill book company
4	Ground Water Assessment, Development & Management	K.R. Karanth	Tata Mc Graw Hill Co. Ltd., New Delhi
5	Hydrogeology	K.R. Karanth	Tata Mc Graw Hill Pub Co. Ltd., New Delhi
6	Groundwater Hydrology	Herman Bower	McGraw-Hill, Kogakusha Ltd. Int. Student Edn. 1978
7	Related I S Codes		BIS, New Delhi

A. LIST OF RECOMMENDED I.S. PUBLICATIONS:

B. List of Major Equipment/Materials

- i. Working models of recharging works.
- ii. Models of rain water harvesting structures
- iii. Models of tube well.

C List of Software/Learning Websites

- i. www.nptel.ac.in
- ii. www.ocw.mit.edu
- iii. www.ngwa.org/ iv. www.groundwaterinternational.co
- v. www.cgwb.gov.in
- vi. wrmin.nic.in
- vii. www.cwc.nic.in
- viii. www.cgwb.gov.in/Research_and_Development.html

11. PO-COMPETENCY-CO MAPPING:

Semester VI	Ground Water Engineering (Course Code:)						
	POs						
Competency & Course Outcomes	Basic Discipline specific knowledge	Problem Analysis	Design/ Development of Solutions	Engineering tools, Experimentation and Testing	Engineering Practices for society, Sustainability and Environment	Project Management	Life-long Learning
<u>Competency</u>	Take steps to enhance ground water recharge and prevent its contamination.						
Course Outcomes CO1 Interpret different terms related to ground water and process of ground water survey.	2	0	0	2	3	0	2
CO2 Find suitable method of artificial recharge of ground water for given conditions.	3	2	2	0	3	0	3
CO3 Design a tube well for given condition.	3	2	2	2	3	0	2
CO4 Interpret mechanism of sea water intrusion & controlling measures for sea water intrusion.	3	0	0	0	3	0	3

Legend: '3' for high, '2' for medium, '1' for low and '-' for no correlation of each CO with PO.

12. COURSE CURRICULUM DEVELOPMENT COMMITTEE

GTU Resource Persons

Sr. No.	Name and Designation	Institute	Contact No.	Email
1.	Shri Anil K Popat Senior Lecturer (Civil)	R C Technical Institute, Sola, Ahmedabad	9825443501	anilkpopat@gmail.com
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