



GUJARAT TECHNOLOGICAL UNIVERSITY

Program Name: Diploma Engineering

Level: Diploma

Branch: Civil Engineering

Subject Code: DI04006051

Subject Name: Ground Water Engineering

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

Prerequisite:	Students should have basic knowledge of hydrology, hydraulics, and environmental engineering. They must understand the hydrologic cycle, fluid properties, and water quality parameters. Familiarity with surveying and engineering drawing will also help in studying aquifers, wells, and recharge structures.
Rationale:	Groundwater is an essential part of the hydrological cycle and forms a crucial source of water for domestic, industrial, and agricultural use in India. With increasing population, urbanization, and industrialization, dependence on groundwater has grown, leading to over-extraction and quality deterioration. Civil Engineers must understand aquifers, well hydraulics, artificial recharge methods, groundwater quality, and management practices. This subject equips students with applied knowledge and practical skills for surveying, developing, conserving, and sustainably managing groundwater resources.

Course Outcome:

After Completion of the Course, the students will be able to:

No	Course Outcomes	RBT Level
01	Explain the sources, occurrence, and properties of groundwater	R, U, A
02	Carry out groundwater survey methods and assess groundwater quality.	R, U, A
03	Suggest appropriate artificial recharge structures for different field conditions and simple wells and tube wells	R, U, A
04	Analyze the problem of seawater intrusion and propose remedial measures for the conservation of ground water.	R, U, A

*Revised Bloom's Taxonomy (RBT)



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Teaching and Examination Scheme:

Teaching Scheme (in Hours)			Total Credits L+T+ (PR/2)	Assessment Pattern and Marks				Total Marks
L	T	PR	C	Theory		Tutorial / Practical		
				ESE (E)	PA (M)	PA (I)	ESE (V)	
03	00	02	04	70	30	20	30	150

Course Content:

Unit No.	Content	No. of Hours	% of Weightage
1	<p>Introduction to Groundwater:</p> <p>1.1 Sources of water</p> <p>1.2 Hydrological cycle and role of groundwater.</p> <p>1.3 hydrological properties of water bearing strata</p> <p>1.4 Distribution of subsurface water: zone of aeration, zone of saturation, water table.</p> <p>1.5 Types of Aquifers:– confined, unconfined, perched, artesian. Aquiclude, aquitard, aquifuge..</p> <p>1.6 Properties of aquifers: Porosity, void ratio. Specific yield, specific retention, Hydraulic conductivity, transmissibility, storage coefficient.</p> <p>1.7 Causes of changes in groundwater quantity (natural & man-made).</p> <p>1.8 Causes of fluctuation in groundwater quantity (recharge, discharge, seasonal variations, overuse)</p>	06	14
2	<p>Groundwater Survey & Quality:</p> <p>SURVEY METHODS:</p> <p>2.1 Surface surveys: geological, geomorphological, soil, remote sensing, surface geophysics.</p> <p>2.2 Subsurface surveys: exploratory drilling, borehole logging, electric logging, radioactive logging.</p> <p>2.3 Importance of geophysical survey in groundwater exploration.</p> <p>GROUNDWATER QUALITY:</p> <p>2.4 Physical, chemical, and biological characteristics of groundwater.</p> <p>2.5 Parameters: pH, TDS, EC, hardness, alkalinity, chloride, nitrate, fluoride.</p> <p>2.6 IS and WHO standards for drinking water.</p>	10	23



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	<p>2.7 Causes of quality degradation: industrial pollution, agricultural runoff, seawater intrusion.</p> <p>2.8 Methods of improving groundwater quality: treatment, blending, artificial recharge.</p> <p>2.9 GROUNDWATER CONTAMINATION:</p> <ul style="list-style-type: none">• Sources – industrial effluents, fertilizers, pesticides, urban waste.• Remedial & preventive measures.		
3	<p>Artificial Recharge & Conservation:</p> <p>3.1 Concept and need for artificial recharge in India.</p> <p>3.2 Objectives: augmenting groundwater storage, preventing overdraft, controlling decline in water table.</p> <p>3.3 Techniques of artificial recharge:</p> <p>3.3.1 Surface spreading methods – spreading basins, percolation tanks, check dams.</p> <p>3.3.2 Subsurface methods – recharge wells, injection wells, shaft recharge.</p> <p>3.3.3 Rooftop rainwater harvesting and urban recharge.</p> <p>3.4 Suitability, advantages and limitations of methods.</p> <p>3.5 Identification of recharge zones using geological and hydrological criteria.</p> <p>3.6 Case studies of artificial recharge projects in India.</p>	10	22
4	<p>Wells & Tube Wells :</p> <p>4.1 Introduction to wells and tube wells, importance in irrigation and water supply.</p> <p>4.2 Classification: open wells, dug wells, tube wells (shallow, deep, cavity, slotted pipe, strainer type).</p> <p>4.3 Difference between wells and tube wells.</p> <p>4.4 Well hydraulics: Darcy's law applications, specific yield, well losses, safe yield, interference of wells.</p> <p>4.5 Construction methods of wells and tube wells – site selection, drilling methods, well development.</p>	10	21



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	4.6 Pumping equipment: plunger pump, jet pump, submersible pump, air lift pump. 4.7 Design of a simple tube well – steps, size, design considerations, yield estimation.		
5	Seawater Intrusion & Groundwater Management 5.1 Causes of seawater intrusion in coastal aquifers. 5.2 Mechanism: Ghyben-Herzberg principle, interface of freshwater-seawater. 5.3 Effects of seawater intrusion: salinity increase, degradation of water quality, impact on agriculture. 5.4 Preventive measures: pumping control, artificial recharge barriers, freshwater injection, subsurface dams. 5.5 Groundwater basin management: balancing recharge and discharge. 5.6 Conjunctive use of surface water and groundwater resources. 5.7 Sustainable management strategies in India.	09	20
	Total	45	100

Suggested Specification Table with Marks (Theory): (in %)

Distribution of Theory Marks (in %)					
R Level	U Level	A Level	N Level	E Level	C Level
30	40	30	-	-	-

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	Groundwater Hydrology	Raghunath H.M	Wiley Eastern Ltd
2	Numerical Ground Water Hydrology	Rastogi., A.K.	Ulhas Phatak for Penra International (I) Pvt.ltd. Mumbai, 2007
3	Groundwater Hydrology	Herman Bower	McGraw-Hill
4	Groundwater Assessment,	K.R. Karanth	Tata McGraw-Hill



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S. No.	Title of Book	Author	Publication with place, year, and ISBN
	Development and Management		
5	Hydraulics of Ground Water	Bear J.,	Dover Publication
6	Relevant IS Codes (BIS – Drinking water quality standards, well construction standards).		

(b) Open-source software and website:

1. www.cgwb.gov.in
2. www.ocw.mit.edu
3. www.ngwa.org/
4. www.groundwaterinternational.co
5. www.cgwb.gov.in
6. wrm.in.nic.in
7. www.cwc.nic.in
8. www.nptel.ac.in

Suggested Course Practical List:

Exp. No.	List of Practicals	Unit No.	Approx. hrs. Required
1	Draw the sketches of Hydrological cycle Types of Aquifers Zone of Distribution Surface spreading methods Subsurface methods Various types of wells and tube wells Sea water intrusion Rain Water Harvesting	I,II,III,IV,V	04
2	Water quality tests:	II	08
	1.Determination of pH, electrical conductivity.	II	
	2. Determination of hardness, alkalinity, TDS.	II	
3	Solve the numerical for the given data:	II	04
	1. Numerical exercise on Darcy's law	IV	
	2. Solve the numerical related to salt water Intrusion.	V	
4	Case study/report on local artificial recharge project.	III	02
5	Field visit:.	III	06
6	1. Tube well or pumping station.	IV	02
	2. Rainwater harvesting/artificial recharge structure	III	



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	3. Irrigation/water resources department for groundwater data collection.	I	
7	Select a topic as a seminar and present it using modern teaching aids.	I,II,III,IV	04
Total			30

List of Laboratory/Learning Resources Required:

S. No.	Equipment Name	Experiment No.
1	Water testing kits (for pH, TDS, hardness, EC).	3
2	Water level indicator.	6
3	GPS & surveying instruments (for mapping recharge sites).	4,6

Suggested Project List: As per the Suggested Course Practical List

Suggested Activities for Students:

1. Prepare a working model of artificial recharge structure (check dam, percolation tank).
2. Develop a model of tube well or pumping system.
3. Prepare a survey report on groundwater depletion in local area.
4. Conduct awareness campaign on rainwater harvesting and groundwater conservation in community.
5. Prepare a technical poster or seminar presentation on seawater intrusion.

Teaching–Learning Strategies:

- Use of **charts, models, videos, animations** for aquifers, well hydraulics, seawater intrusion.
- Field-based learning through **site visits**.
- **Guest lectures** from groundwater department officials.
- **Case study method:** successful recharge projects in Gujarat & India.
- ICT tools: NPTEL lectures, CGWB portal, IS codes.

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