

GUJARAT TECHNOLOGICAL UNIVERSITY, AHMEDABAD, GUJARAT

COURSE CURRICULUM
COURSE TITLE: GROUND WATER ENGINEERING
(COURSE CODE: 3360609)

Diploma Programme in which this course is offered	Semester in which offered
Civil Engineering	Sixth

1. RATIONALE:

Ground water is most important source of fresh water. Due to over exploitation and pollution of fresh water sources of surface water, ground water is the only remaining source to satisfy different types of water demands like irrigation, industrial, drinking water etc. However, the ground water table is also decreasing due to excess pumping and lack of recharging. There are also concerns about the contamination of ground water. In this scenario it is must for civil engineers working in the area of water resource management to take measures to improve ground water recharging and avoid contamination. This course attempts to provide knowledge and skills for effective ground water management. Thus this course is very important course in present scenario.

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 recharge ground water 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.

- Conduct ground water survey work to check the quantity and quality of ground water.
- Apply methods to recharge ground water.
- Design the wells.
- Take measures for prevention of sea water intrusion.

4. TEACHING AND EXAMINATION SCHEME

Teaching Scheme (In Hours)			Total Credits (L+T+P)	Examination Scheme				Total Marks
L	T	P		Theory Marks		Practical Marks		
L	T	P	C	ESE	PA	ESE	PA	150
3	0	2	5	70	30	20	30	

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 Sub-topics
UNIT-I Introduction	1.1 Explain the occurrence of Groundwater 1.2 Define various terms related to groundwater 1.3 Explain Aquifers 1.4 Explain permeability 1.5 Describe causes of changes in ground Water quality & quantity	1.1 Groundwater scenario of India 1.2 Origin of Groundwater 1.3 Groundwater Characteristics 1.4 Define: - Hydraulic conductivity - Transmissibility - Specific yield - Storage coefficient 1.5 Aquifer-Types of aquifer 1.6 Permeability- Darcy's permeability 1.7 Causes & Effects of changes in ground water quality 1.8 Causes & Effects of changes in ground water quantity
UNIT-II Ground water Survey and Water Quality	2.1 Describe groundwater Quality 2.2 Describe reasons for ground Water quality degradation 2.3 Explain Improvement of Groundwater quality.	2.1 Geophysical survey of ground water - Surface Geophysical techniques - Electric logging & Radioactive logging Method 2.2 Ground water quality - Factors affecting ground water quality 2.3 Water quality requirements 2.4 Groundwater quality degradation 2.5 Reasons of groundwater quality degradation
UNIT-III Ground Water Development	3.1 Describe ground-water development 3.2 Describe methods of Artificial recharging 3.3 Describe suitability of recharging methods	3.1 Introduction 3.2 Development of Artificial recharging 3.3 Methods of artificial recharging 3.4 Suitability of artificial recharging methods

Unit	Major Learning Outcomes (in Cognitive Domain)	Topics and Sub-topics
UNIT-IV Well Hydraulics	4.1 Explain wells 4.2 Describe well losses 4.3 Explain method of construction of wells 4.4 Design the wells	4.1 Introduction 4.2 Types of wells - Open wells - Tube wells 4.4 Well losses 4.5 Specific capacity 4.6 Interference among wells 4.7 Fully penetrating gravity wells 4.8 Partially penetrating gravity wells 4.9 Safe yield of well 4.10 Method of construction of wells 4.11 Selection of pump sets - Plunger pump - Jet pump - Submersible pump - Air lift pump 4.12 Design of Tube well
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 5.4 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 water-sea water Interface 5.6 Remedial measures to control sea water intrusion 5.7 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 water quality	08	06	04	04	14
III	Ground water development	08	05	05	04	14
IV	Well hydraulics	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	Prepare drawing of Representation of coefficient of storage of ground water	
	II	Develop an illustration of Aquifers	
	III	Prepare a list of various types of wells in the states with sketches	
	IV	Develop an illustration of Artificial recharge methods of ground water	
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 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

- i. Prepare a model/prototype of groundwater recharging structure in the college/suggested Premises.
- ii. Prepare a model/prototype of tube well in the suggested premises.
- iii. Explore internet to study different issues related to ground water level and Contamination and prepare a report.
- iv. Prepare a report on Remote Sensing Method for ground water Survey
- v. 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)

- i. Show video films of sea water intrusion and its effects
- ii. Arrange expert lectures of Engineers working in ground water department/geological survey of India.
- iii. 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

B. LIST OF RECOMMENDED I.S. PUBLICATIONS:

C. List of Major Equipment/Materials

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

D 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. COURSE CURRICULUM DEVELOPMENT COMMITTEE

Faculties from Polytechnics of Gujarat

- **Prof. M. J. Zala**, Sr. Lecturer, B & B Institute of Technology, V.V. Nagar.
- **Dr. S.K. Dave**, I/C Head Civil Engg. Dept(S.F) Sr. Lecturer, B & B Institute of Technology, V.V. Nagar.
- **Prof. Rina K. Chokshi**, Head, Parul Institute of Engineering & Technology (Diploma Studies), Vadodra
- **Prof. Vandana P. Pandya**, Head Civil Engg., Parul Polytechnic Institute, Vadodra

Coordinator and Faculty Members from NITTTR Bhopal

- **Prof. M.C. Paliwal**, Associate Professor, Department of Civil and Environmental Engineering.
- **Prof. V. H. Radhakrishnan**, Professor, Department of Civil and Environmental Engineering.