

**B. Tech. III Semester VI**

**Subject Name** : Ground Water Hydrology

**Subject Code:** BTCL14607

**Type of course** : PEC - III

**Prerequisite** : Hydrology and Water Resource Management (BTCL13504)

**Rationale** : Students will be able to understand aquifer properties and its dynamics after the completion of the course. It imparts exposure towards well design and practical problems of ground water aquifers.

Teaching and Examination Scheme:									
Teaching Scheme				Theory Marks			Practical Marks		Total
L	T	P	C	TEE	CA1	CA2	TEP	CA3	100
3	0	0	3	60	25	15	-	-	

**CA1:** Continuous Assessment (assignments/projects/open book tests/closed book tests) **CA2:** Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems **TEE:** Term End Examination **TEP:** Term End Practical Exam (Performance and viva on practical skills learned in course) **CA3:** Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Content:**

Sr. No.	Topics	Teaching Hrs.	Module Weightage
1	<b>Introduction:</b> Groundwater in Hydrologic Cycle – Occurrence of groundwater – Hydrogeology – Hydrometeorology – soil sample analysis - Water bearing materials - Types of aquifers – parameters of Aquifers – Determination of specific yield and permeability	08	15%
2	<b>Groundwater Hydraulics:</b> Groundwater Movement - Darcy's law and its limitations - Stream lines and flow net analysis – Potential flow theory – Discharge and draw down for various condition of groundwater flow - Principles of groundwater flow and its equation – Dupuit– Forchheimer assumptions – Influent and Effluent streams - Evaluation of well loss parameters – Partial penetration of wells – Interference of wells – Collector wells and Infiltration galleries.	10	25%
3	<b>Pumping Test Analysis:</b> Determining aquifer parameters for unconfined, leaky and non-leaky aquifers – steady and transient conditions - Slug test – Locating hydro geological boundaries – Image well theory – Determination of well characteristics and specific capacity of wells – Well characteristics of large diameter wells.	10	25%
4	<b>Well Design and Construction:</b> Well design criteria – Construction of wells – Well drilling methods – Filter design – Artificial and natural packing – Well castings and screens – Production test – Maintenance of production wells.	09	20%
5	<b>Special Topics:</b> Methods of artificial groundwater recharge – Groundwater assessment and balancing – Seawater intrusion in coastal aquifers – Land Subsidence - Wells in hard rock areas - regional groundwater flow modeling.	08	15%

**Suggested Specification table with Marks (Theory/Practical):**

<b>% Distribution of Marks</b>					
<b>R Level</b>	<b>U Level</b>	<b>A Level</b>	<b>N Level</b>	<b>E Level</b>	<b>C Level</b>
15	20	20	15	15	15

**Legends: R:** Remembrance, **U:** Understanding; **A:** Application, **N:** Analyze, **E:** Evaluate **C:** Create and above Levels (**Revised Bloom's 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.

**Reference Text Books:**

Sr. No.	Title of book /article	Author(s)	Publisher and details like ISBN	Year of Publication	Publication Edition
1.	Groundwater Hydrology	Todd D.K., Larry W. Mays	John Wiley & Sons, Inc, New York; ISBN: 978-0-471-05937-0	2004	3 <sup>rd</sup>
2.	Hydraulics of Groundwater	Bear J.	McGraw-Hill, New York; ISBN 0070041709	1979	1 <sup>st</sup>
3.	Groundwater Hydrology	Bouwer H.	McGraw-Hill, New York;	1978	1 <sup>st</sup>
4.	Groundwater and Wells	Driscoll	Johnson Filtration Systems, Inc.; ISBN 0-9616456-0-1	1986	2 <sup>nd</sup>
5.	Groundwater Hydrology: Engineering, Planning and Management	Karamouz, M, Ahmadi, A, and Akhbari, M	CRC Press; ISBN 9780367211479	2020	2 <sup>nd</sup>
6.	Concepts and Models in Groundwater Hydrology	Domenico	McGraw Hill Inc. New York; ISBN 10: 0070175357; ISBN 13: 9780070175358	1972	1 <sup>st</sup>

**Course Outcome:**

Sr. No.	CO Statement After learning this subject, students will be able to	Marks % weightage
CO-1	Model regional groundwater flow and design water wells. (R, U ...- Cognitive Level)	10
CO-2	Formulate and solve conjunctive use of surface water and groundwater resource utilization problems. (N, E ...- Cognitive Level)	20
CO-3	Identify sites for artificial recharge of groundwater and determine the consequences of artificial recharge. (A, E, C ...- Cognitive Level)	25
CO-4	Conduct Geophysical exploration studies for groundwater source identification.(A, N, E ...- Cognitive Level)	25
CO-5	Recognise the various methods of field measurements and estimation of precipitation and runoff process which apply to carry out the assessment of water balance and runoff potential. (A, N ...- Cognitive Level)	20

**Mapping with POs:**

	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
<b>CO-1</b>	1	2	2	1	1	1	1	1	1	1	2	1	1	1	1
<b>CO-2</b>	1	3	2	3	2	1	2	1	1	2	1	2	2	2	2
<b>CO-3</b>	2	1	1	3	1	2	2	2	2	1	-	2	1	1	2
<b>CO-4</b>	2	1	-	1	2	1	-	1	2	1	-	-	3	1	1
<b>CO-5</b>	3	2	2	2	1	2	2	3	2	2	1	2	1	2	3
<b>Rationale *</b>	<b>9</b>	<b>9</b>	<b>7</b>	<b>10</b>	<b>7</b>	<b>7</b>	<b>7</b>	<b>8</b>	<b>8</b>	<b>7</b>	<b>4</b>	<b>7</b>	<b>8</b>	<b>7</b>	<b>9</b>

**Rationale\*:** All the COs are satisfying the well-defined POs & PSOs up to the certain extent. Students will be able to understand the groundwater fundamentals and model-making techniques through the application of science, engineering, planning, and management principles.

**List of Open Source/learning website:**

- <https://nptel.ac.in/courses/105/103/105103026/>
  - Detail of coverage as Groundwater Management, well Hydraulics etc.
- <https://pubs.usgs.gov/wsp/2220/report.pdf>
  - Detail of coverage as Basics of Groundwater Hydrology
- <http://cgwb.gov.in/Ground-Water>
  - Detail of coverage as Central Ground Water Board (CGWB)
- <https://www.mooc-list.com/tags/groundwater>
  - Detail of coverage as Groundwater Cycle, Flow, Contamination
- <https://www.coursera.org/lecture/fe-exam/groundwater-t9wnK>
  - Detail of coverage as Hydraulics and Hydrologic system
- <https://ocw.mit.edu/courses/civil-and-environmental-engineering/1-72-groundwater-hydrology-fall-2005/lecture-notes/>
  - Detail of coverage as Groundwater flow nets, Pump Analysis etc.

**List of Open Source Software:**

- QGIS
- GWM
- SEAWAT
- Groundwater Toolbox
- GAMACTT