

<b>7<sup>th</sup> Semester</b>	<b>RAG7D001</b>	<b>Ground Water, Wells and Pumps</b>	<b>L-T-P 3-0-0</b>	<b>3 Credits</b>
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### **Module I ( 8 hr)**

Introduction to ground water, wells and pumps: occurrence and distribution of ground water; properties affecting groundwater, vertical distribution of groundwater; Aquifers Types, geologic formations and aquifer properties; Ground water movement – Darcy law, coefficient of permeability/ hydraulic conductivity, general flow equation, ground water flow direction-flow nets, flow in relation to groundwater contours, flow across a water table, flow across a boundary of different hydraulic conductivity.

### **Module II (10 hr)**

Groundwater and well hydraulics – Steady unidirectional flow in confined aquifer, flow in unconfined aquifer, steady radial flow to a well in confined and unconfined aquifer, steady radial flow in unconfined aquifer with uniform recharge, Unsteady radial flow in confined aquifer, Theis, Cooper-Jacob method, Chow method of solution, Theis recovery method etc., Unsteady radial flow in an unconfined aquifer, Unsteady radial flow in leaky aquifer, Well flow near aquifer boundaries (near a stream), Well flow near aquifer boundaries (other boundaries).

### **Module III (9 hr)**

Multiple well system, partially penetrating wells, well losses, specific capacity etc.; Water wells – Types, Method of drilling deep wells, well completion, Well design, protection of wells, Selection of wells, Development of wells and well testing; Surface investigation of ground water – Geologic, remote sensing, geophysical exploration, electrical resistivity, seismic refraction, magnetic, water witching methods; Sub surface investigations of ground water – Drilling tests, water level measurement, geophysical, resistivity, potential, radiation, temperature, caliper logging; Artificial recharge of ground water – concept and different methods of recharging

### **Module IV (9 hr)**

Sea water intrusion – Occurrence of saline water, intrusion, relation between fresh and salt water intrusion; Control, recognition of sea water in ground water; Quality of ground water – Sources, measurement of water quality, chemical, physical and biological analysis; Ground water sampling, water quality criteria; Water lifting devices-Manual and animal drawn water lifting devices, positive displacement pumps; Different types of pumping machinery, Reciprocating pumps and Classification of variable displacement pumps and component parts of centrifugal pumps.

### **Module V (9 hr)**

Power requirement in pumping; Centrifugal pumps-Performance characteristic curves of centrifugal pumps and pump selection, Effect of speed and impeller diameter on head capacity, discharge, power requirement and efficiency of centrifugal pumps, Design of

centrifugal pumps; Priming and self-priming devices, Installation of centrifugal pumps, Trouble shooting of centrifugal pumps, Roto-dynamic pumps and their classification; Deep well turbine pumps; Submersible pumps: Introduction, working principle, construction details, storage and preservation of submersible pump, common causes of breakdown of submersible pump, common troubles and remedies.

**Books:**

1. D.K. Todd, Ground water hydrology, John Wiley & Sons, New York
2. S. P. Garg, Groundwater and tube wells, Oxford & IBH Publishing Co.Ltd., New Delhi.
3. H.M.Raghunath, Ground water, new age publications, New Delhi
4. A. M. Michael, S. D. Khepar and S. K. Sondhi. Water well & Pump Engineering, Tata
5. Mc-Graw Hill
6. R. Lal. Irrigation Hydraulics, Saroj Prakashan, Allahabad-02
7. H.S. Nagabhusan Ground water hydrology, CBS Publishers and Distributors, New Delhi.
8. J.C. Paul and B. Panigrahi. Practical Manual on Ground Water Hydrology, CAET, OUAT, Bhubaneswar

***Digital Learning Resources:***

<https://www.un-igrac.org/what-groundwater>

<http://cgwb.gov.in/documents/papers/incidpapers/Paper%201-B.M.Jha.pdf>

<https://www.ngwa.org/what-is-groundwater/About-groundwater/dissolved-mineral-sources-and-significance>

<http://ecoursesonline.iasri.res.in/mod/page/view.php?id=124685>

<https://wellowner.org/resources/basics/types-of-wells/>

<https://www.plumbingsupply.com/wellpart.html>