



SEC007

GROUNDWATER MODELING

Unit I

This unit introduces the fundamentals of groundwater hydrology and the role of modelling in understanding subsurface water flow. It covers the basic concepts of aquifers, aquitards, and aquiclude, along with governing equations of flow derived from Darcy's Law and the continuity equation. Students learn the purpose, types, and applications of groundwater models in predicting water movement and assessing aquifer sustainability.

Unit II

This section explains the development of conceptual and mathematical models of groundwater systems. It includes the formulation of flow equations under steady and transient conditions and boundary conditions used in modelling. The unit emphasizes simplification techniques, assumptions, and analytical solutions for flow in confined and unconfined aquifers. Students also learn to convert real-world hydrogeologic problems into mathematical representations.

Unit III

This unit focuses on numerical methods such as finite difference and finite element techniques used in groundwater flow simulation. Students explore the discretization process, grid design, stability, and convergence criteria. Practical exposure is given to groundwater simulation software like MODFLOW for constructing numerical models, defining input parameters, and interpreting output data.

Unit IV

Students learn procedures for model calibration and validation using observed field data to ensure reliability and accuracy. The unit covers parameter estimation, sensitivity analysis, and uncertainty assessment to improve model performance. Case examples demonstrate how model calibration supports water resource management and contamination prediction.

Unit V

This concluding unit discusses the practical applications of groundwater models in resource assessment, contamination transport, and artificial recharge planning. It includes simulation of pumping effects, prediction of drawdown, pollutant migration, and saltwater intrusion. The importance of integrated groundwater-surface water modelling and sustainable aquifer management strategies are highlighted through case studies and project-based learning.