Preface

Groundwater is an important resource, and its exploration, planning, and management play a significant role in the effective utilization of it for domestic, irrigation, industrial, and other purposes. Groundwater hydrology deals with quality and quantity aspects of groundwater, and it is a broad field with many ramifications. There is an ever-increasing demand for information on groundwater hydrology by students and professionals in several fields. In this book, an attempt has been made to present the basic principles of groundwater movement in aquifers and management of groundwater. The principles of groundwater flow are presented through elaborate derivation of governing differential equations and their analytical solutions for simple boundary conditions. At the same time, the book incorporates sufficient theoretical material to grasp the concepts even by bypassing the clutter of mathematical equations. It has an appropriate focus on both aspects of groundwater: resource development as well as contamination transport and quality management. There is a separate chapter on groundwater flow solution by complex analysis, and the book contains substantial original material on solutions by the author to seepage from canals using conformal mapping, stream-depletion problem, flowing-well problem, and some case studies. The book has a broader scope due to comprehensive coverage on most aspects of groundwater, and it enables the readers to acquire a basic understanding of the groundwater hydrology for addressing groundwater issues. The book has been written to serve the needs of undergraduate and graduate students and professionals in hydrogeology, groundwater engineering, water resources engineering, agricultural engineering, earth sciences, water resources management, geotechnical engineering, and environmental sciences.

Salient Features of the Book

- Comprehensive coverage on most of the aspects of groundwater to suit undergraduate and postgraduate syllabi of different programs of various universities
- Principles of groundwater flow presented through elaborate derivation of governing differential equations and their analytical solutions for simple boundary conditions
- Incorporates sufficient theoretical material to grasp the concepts even by bypassing the clutter of mathematical equations
- Appropriate focus on both aspects of groundwater: resource development and contamination transport and quality management
- Contains substantial original material on solutions by author to seepage from canals using conformal mapping, stream-depletion problem, flowing-well problem, and some case studies

- Separate chapters on groundwater flow solution by complex analysis, and flow through unsaturated media
- Large number of solved examples and variety of numerical problems designed on semester and competitive examination patterns
- Rich pedagogy including illustrations, solved examples, numerical problems, and theory questions

Chapter Organization

The book contains 19 chapters, which are clubbed into four parts. Part I includes Chapters 1–4, which are related to groundwater occurrence, distribution, and exploration along with well construction and logging. Part II deals with theoretical aspects of groundwater flow comprising Chapters 5–9; whereas Part III is devoted to well hydraulics consisting Chapters 10–14. The groundwater management issues are incorporated in Part IV through Chapters 15–19. The following are the highlights of the individual chapters. Chapter 1 defines groundwater and its occurrence and distribution in porous media as well as properties of the porous media. Chapter 2 deals with aquifers in detail and groundwater scenario in India. Chapter 3 describes various techniques elaborately to investigate, target, and map the distribution and availability of groundwater in adequate quantity of good quality. Site selection for wells, different methods of well logging, well-construction techniques, and well-completion steps are discussed elaborately in Chapter 4, whereas Chapter 5 introduces principles of groundwater movement in porous media in a generalized way including Darcy's law and transformation of medium. Chapter 6 covers theory of groundwater flow which incorporates derivation of governing equations and analytical solutions for simple groundwater-flow problems. Chapter 7 presents contaminant transport in groundwater with emphasis on the origin and sources of contaminants in groundwater, classification of groundwater contamination, transport mechanism, and governing equations for contaminant transport in saturated porous media. Chapter 8 deals with functions of complex variables, different types of mappings and their application in solving groundwater-flow problems. Properties of unsaturated medium, water-retention characteristics, hydraulic conductivity relations, derivation of flow equations in unsaturated porous medium, and infiltration of surface water are incorporated in Chapter 9. Chapter 10 describes governing equations in radial coordinates and steady-state solutions to flow problems for cases of single wells, multiple wells and wells in uniform flow field; whereas Chapter 11 addresses solutions to problems for unsteady-state flow in confined aquifers toward fully penetrating wells such as single wells, multiple wells, and wells near different boundaries. Chapter 12 incorporates in detail the unsteady-state solutions to flow problems for special cases, namely wells in unconfined aquifers, wells in leaky aquifer, partially penetrating wells in confined aquifers, large diameter wells, flowing wells, wells in multiple-layer aquifers, and well losses. Estimation of aquifer parameters is one of the most important aspects of well hydraulics, and Chapter 13 explains pumping test and slug test techniques for estimating aquifer parameters for confined, unconfined, and leaky aquifers. Detailed description of aspects related to design, development, and maintenance

of water wells is included in Chapter 14. The key issues and various methods of artificial recharge of groundwater are presented in Chapter 15; whereas Chapter 16 deals with the different concerns of saline-water intrusion in aquifers. Introduction and importance of groundwater modeling, classification and description of groundwater models, and finite difference method for groundwater modeling are covered in Chapter 17. Finally, the salient features of management of groundwater quantity and quality are incorporated in Chapters 18 and 19, respectively.

Online Learning Center

The text is accompanied by an exhaustive website accessible at *http://www.mhhe.com/chahar/gh1* which contains the following material.

For Instructors

- Solutions Manual
- Lecture PPTs

For Students

- Chapter-wise MCQs
- Exhaustive Bibliography

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Feedback

I realize that the first edition is bound to have defects. I will appreciate suggestions directed toward the improvement of this book.

July 2014, New Delhi

Bhagu R Chahar

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