Hydrology 603A

WELL HYDRAULICS AND PUMPING TEST ANALYSIS

SPRING 2007

3 Units

Instructor: S.P. Neuman, J. W. Harshbarger Bldg., Room 232 G, 621-7144
e-mail: neuman@hwr.arizona.edu
Office Hours: Tuesday and Thursday, 1:00 - 2:00 p.m.
Classes: Tuesday and Thursday, Room and Time TBA
Text: Class Notes.

Outline of Lectures:

Filtering out long term trends, barometric and tidal effects

Confined aquifers
   Derivation of Theis equation
   Quasisteady state: The Thiem equation
   Variable pumping rate
   Recovery
   Lateral boundaries
   Horizontal anisotropy (three-well method of Neuman et al.; WIPP case study)
   Partial penetration and vertical anisotropy (Hantush solution)
   Skin effect and well efficiency
   Wellbore storage (derivation of Papadopulos-Cooper solution)
   Type curves including time derivative
   Well of finite radius without storage (derivation of van Everdingen-Hurst solution)
   Observation well and piezometer storage (Hvorslev and Black-Kipp methods)
   Slug tests (derivation of Cooper, Bredehoeft and Papadopulos solution)
   Pumping well at constant head (derivation of van Everdingen-Hurst, Jacob-Lohman solution)

Leaky aquifers
   Classical theory (Hantush-Jacob)
   Modified theory (Hantush)
   Ratio method (Neuman-Witherspoon; Oxnard case study)
   Multiaquifer systems (Neuman-Witherspoon; Oxnard case study)
   Deconvolution method (Neuman-Gardner; A case study)

Unconfined aquifers
   Boulton’s delayed yield model (Pricket method)
   Neuman’s delayed gravity response model (partial penetration & vertical anisotropy)
   Confined-unconfined transition (Ehlig & Halepaska)
   Slug-tests (Bower & Rice method)
   Effect of unsaturated flow (Tartakovsky and Neuman; Cape Cod case study)

CONTINUED
Fractured rocks
   Cross-hole tests and 3-D anisotropy (Hsieh-Neuman method; Oracle case study)
   Dual continuum models (Barenblatt and Gringarten models)
   Diagnosis via derivative method (WIPP case study)
   Pumping wells intersected by dykes, faults and major fractures
   Slug test intervals intersected by discrete fractures

Pneumatic tests
   Single-hole (Illman & Neuman; Apache Leap case study)
   Cross-hole (Illman & Neuman; Apache Leap case study)
   Pneumatic tomography (Vesselinov et al.; Apache Leap case study)

Heterogeneous formations
   Composite aquifers
   Randomly heterogeneous aquifers (Method of Neuman et al.; Tubingen case study)
   Scale effects (Apache Leap case study)

**Examination:**

There will be one 1-hour closed book mid-term examination on Thursday, March 8. In addition, there will be a closed book final examination (date to be assigned).

**Assignment of Grades:**

The overall grade in the course will be determined as follows:

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<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
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<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
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<td>Midterm</td>
<td>35%</td>
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<tr>
<td>Final</td>
<td>45%</td>
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<tr>
<td>Overall Grade</td>
<td>100%</td>
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**Software:** We will be using the departmental version of Aqtesolv.

**Reference Books:**