Hydrology 504

NUMERICAL METHODS IN SUBSURFACE HYDROLOGY

SPRING 2011

4 Units

Instructor: S.P. Neuman, J. W. Harshbarger Bldg., Room 232 C, 621-7144
E-mail: neuman@hwr.arizona.edu
Office Hours: 2:00 - 3:00 p.m. Tuesday and Thursday
Classes: Harshbarger 232, 12:00 - 1:50 p.m. Tuesday and Thursday
Text: Class Notes.

Outline of Lectures:

Finite difference methods for nonsteady and steady state groundwater flow
   Explicit 1D non-steady flow equation
   Concepts of stability, convergence, accuracy, consistency
   Implicit 1-D non-steady flow equation
   Quasilinear forms (unsaturated/unconfined flows)
   2-D steady and non-steady flow; Alternating Direction Implicit Procedure (ADIP)

Direct solution techniques for algebraic equations
   Gaussian elimination
   LU-decomposition
   Cholesky method
   Thomas' algorithm

Iterative solution techniques for algebraic equations
   Point Jacobi method
   Gauss-Seidel method
   Point successive over-relaxation (SOR)
   Line successive over-relaxation (LSOR)
   Iterative Alternating Direction Implicit Procedure (ADIPIT)

Conjugate Gradient Method

Finite volume method

Finite element methods
   Triangular finite elements
   Galerkin method
   Physical interpretation of finite element equation; treatment of sources
   Other weighted residual techniques
   Simplex, complex, multiplex, and isoparametric elements in 2-D and 3-D
Higher order interpolation; Hermitian elements
Mixed explicit-implicit iterative method
Introduction to boundary methods

Transport
Finite difference methods; stability and numerical dispersion
Lagrangian and Eulerian-Lagrangian techniques

Outline of Laboratory Work:

The lab period will be devoted to lectures as well as individual work such as writing
FORTRAN programs for 2-D finite difference, finite element and boundary integral
methods, and homework preparation.

Examination:

There will be one 1-hour closed book mid-term examination on Thursday, March 10.
The final examination is scheduled for 1:00 p.m. - 3:00 p.m. on Wednesday, May 11.

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>Lab work</td>
<td>30%</td>
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<tr>
<td>Homework</td>
<td>10%</td>
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<tr>
<td>Midterm</td>
<td>25%</td>
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<tr>
<td>Final</td>
<td>35%</td>
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<tr>
<td>Overall Grade</td>
<td>100%</td>
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Students with Disabilities:

If you anticipate barriers related to the format or requirements of this course, please meet with
me so that we can discuss ways to ensure your full participation in the course. If you determine
that disability-related accommodations are necessary, please register with Disability Resources
(621-3268; drc.arizona.edu) and notify me of your eligibility for reasonable accommodations.
We can then plan how best to coordinate your accommodations.