

**CWR 6537 Contaminant Subsurface Hydrology**  
**3 credits/Fall Semester**  
**T 3, R 2-3**

Course Description

This course describes solute transport in soils and aquifers. The course material should be of interest to graduate students in both science and engineering. Course discussion topics will include:

- Description and quantification of solute transport processes (diffusion, dispersion, advection, sorption, transformations, etc.)
- Formulation and solution of solute transport equations
- Modeling of water flow and solute transport
- Applications: Groundwater contamination, site remediation, and agricultural non-point source pollution.

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<http://hydrology.ifas.ufl.edu>

Office hours will be following class lecture or by appointment.

Course Objectives

- (a) Learn advanced concepts of water and solute retention and transport in the vadose zone (unsaturated media) and groundwater (saturated media).
- (b) Explore the theoretical aspects of water and solute transport in porous media.
- (c) Examine the inter-relationships among various physical, chemical, and biological processes that influence solute retention, transformations, and transport in porous media.
- (d) Discuss the theoretical bases for experimental methods used to measure various physical and chemical properties relevant to water retention & flow and solute retention & transport in porous media.
- (e) Examine the application of analytical and numerical modeling approaches to solve laboratory-scale and field-scale problems, including process coupling and the design and evaluation of management strategies.

Course Formats and Requirements

3-credit course taught Fall semester with two lectures and one discussion period per week.

Class Attendance

Highly encouraged. Note (below) that class participation counts for 15% of your grade.

Grading System

Mid-term exam (25%), final exam (25%), homework (25%), class participation (15%), final project (10%)

Grade Scale >90=A, 86-90=B+, 80-85=B, 75-79=C+, 70-74=C, 65-69=D+, 60-64=D, <60=E

Grades on assignments submitted after the due date will be penalized. The size of the penalty will be proportional to the time since the due date.

Un-excused absences from exams will result in a zero (0) grade for that exam. Caution: This may have a catastrophic effect on your course final grade!

### Textbook not Required

There is no required text book for the course. Additional lecture notes and references to specific papers will be provided during the semester (available at <http://webct.ufl.edu>). The following texts may provide useful background and additional reference information.

It is emphasized that this course will not follow any of these books in a traditional textbook manner. Purchase of any of these books is only recommended for students who appreciate the value of a supplemental text and reference. If such additional materials are not useful for you, then you should not feel compelled to purchase one of these books.

### *Overview Textbooks*

1. Fetter, C. W., *Contaminant Hydrogeology* (1993) Macmillan, NY.
2. Domenico, P. A. and F. W. Schwartz, *Physical and Chemical Hydrology* (1990) Wiley, NY.
3. Charbeneau, R. J., *Groundwater Hydraulics and Pollutant Transport* (2000) Prentice Hall, NJ.
4. Bedient, P. B., et al. *Ground Water Contamination* (1994) Prentice Hall, NJ.
5. Freeze, R. A. and J. A. Cherry, *Groundwater* (1979) Prentice Hall, NJ.

### *Special Topics*

6. Cussler, E.L., *Diffusion: Mass Transfer in Fluid Systems*, 2<sup>nd</sup> ed. (1997) Cambridge Univ Press, NY.

### *Applications*

7. Collins, A. G., and A. L. Johnson, *Ground Water Contamination: Field Methods* (1988) ASTM, Philadelphia.
8. Chiang, W-H., and W. Kinzelbach, *3D-Groundwater Modeling with PMWIN* (2001), Springer-Verlag, New York

### *Unsaturated Zone*

9. Kutilek, M. and D. R. Nielsen, *Soil Hydrology* (1994) Catena Verlag, Germany.
10. Hillel, D., *Environmental Soil Physics* (1998) Academic Press, New York.

### Written Assignments

Your success as a professional will be based, in large part, on your ability to effectively communicate your ideas. Your success as a scholar will also be dependent on your ability to critically analyze scientific information. We all need practice to develop and improve these technical communication skills.

Periodic reading assignments will require one-page written responses. Responses must be limited to one typed page that includes the following key components:

- Brief description of the article,
- Identify the fundamental concepts,
- How does this information relate to previous information?

- How may this information be applied?

The final project will require a short written report (< 10 pages). You will choose your topic from a list provided by the instructor.

### Philosophical Considerations

A four-tier approach to problem solving will be employed:

1. *Conceptual* description of physical processes,
2. *Mathematical* description of the physics,
3. *Application* to specific scenarios (note that this third step requires a combination of the first and second steps), and
4. *Details*: Consideration of unit conversions, constants of integration, and a host of other factors that are required to arrive at the correct answer.

*God is in the details.*

- Mies van der Rohe

*Der Teufel steckt im Detail.*

(The devil is [hiding] in the details.)

German idiomatic expression

Finally, students are encouraged to challenge their assumptions in all areas of inquiry.

*In the absence of a challenge to a perceived truth, one should be invented.*

- John Stuart Mill

### Academic Honesty

As a result of completing the registration form at the University of Florida, every student has signed the following statements: "I understand that the University of Florida expects its students to be honest in all their academic work. I agree to adhere to this commitment may result in disciplinary action up to and including expulsion from the University."

### UF Counseling Services

Resources are available on-campus for students having personal problems or lacking clear career and academic goals which interfere with their academic performance. There resources include:

1. University Counseling Center, 301 Peabody Hall, 392-1575, personal and career counseling;
2. Student Mental Health, Student Health Care Center, 392-1171, personal counseling;
3. Sexual Assault Recovery Services (SARS), Student Health Care Center, 392-1161, sexual assault counseling; and
4. Career Resources Center, Reitz Union, 392-1601, career development assistance and counseling.

### Accommodation for Students with Disabilities

Students requesting classroom accommodation must first register with the Dean of Students Office. The Dean of Students Office will provide documentation to the student who must then provide this documentation to the Instructor when requesting accommodation.

### Software Use

All faculty, staff and students of the University are required and expected to obey the laws and legal agreements governing software use. Failure to do so can lead to monetary damages and/or criminal penalties for the individual violator. Because such violations are also against University policies and rules, disciplinary action will be taken as appropriate.

We, the members of the University of Florida, pledge to hold ourselves and our peers to the highest standards of honesty and integrity.