

**UNIVERSITY OF CALIFORNIA, DAVIS**  
**DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING**

**COURSE: WATER RESOURCES SIMULATION (ECI 146)**

**INSTRUCTOR: Fabián A. Bombardelli**  
[fabianbombardelli2@gmail.com](mailto:fabianbombardelli2@gmail.com), [bmbdrll@yahoo.com](mailto:bmbdrll@yahoo.com), [fabombardelli@ucdavis.edu](mailto:fabombardelli@ucdavis.edu)  
**OFFICE: 3105, Ghausi Hall (former Engineering III building)**  
**Class: Tuesdays and Thursdays-3:10 to 4:30 PM (119 Wellman)**  
**Computer lab: Fridays-8:00 to 10:50 AM (diverse rooms)**

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**SYLLABUS OF ECI 146, WATER RESOURCES SIMULATION**

**Dates are tentative**

**1. Introduction.**

- 1.a) Importance of water resources (01/10/23).
- 1.b) Definition of simulation. Evaluation of simulation of water resources as a tool for management (01/10/23).
- 1.c) Classification of modeling approximations: 0D, 1D, 2D and 3D (01/12/23).
- 1.d) The Moody chart (01/17/23).

**2. Basic concepts on numerical techniques. Part I.**

- 2.a) Types of equations (01/17/23).
- 2.b) Iterative solution of non-linear equations by the methods of Newton-Raphson, bisection, Regula-Falsi, and iteration of a point (01/17-01/19/23).
- 2.c) Advantages and disadvantages of each method (01/19/23).
- 2.d) Computation of normal-flow depth (01/24/23).

**3. Basic concepts on numerical techniques. Part II.**

- 3.a) Introductory ideas on the solution of ordinary differential equations by finite-difference methods. Stability of the numerical solution (01/24/23).
- 3.b) Approximation of first and higher-order derivatives by finite differences. Explicit and implicit solutions (01/24/23).
- 3.c) Euler and Runge-Kutta methods (01/26/23).
- 3.d) Consistency, convergence and stability of numerical solutions (01/26/23).
- 3.e) Computations of backwater curves by finite differences (01/31/23).
- 3.f) Conceptual description of the finite-element method (FEM) (01/31/23).

**4. Zero-order models for water-quality simulations in water bodies.**

- 4.a) Phenomena associated with pollution in water bodies: Advection and diffusion (02/07/23).
- 4.b) Reactor models for the simulation of the time evolution of phosphorus and nitrogen in lakes. Lake model (02/07/23).
- 4.c) A simple sedimentation-resuspension model for rivers (02/07/23).

**5. Simulation of water retention in ponds and reservoirs.**

- 5.a) Methods for flood-wave routing in reservoirs and rivers (02/09/23).
- 5.b) Hydrologic reservoir modeling (02/09/23).
- 5.c) Reservoir flood management (02/14/23).

**6. One-dimensional hydrodynamic models.**

- 6.a) *Hydrologic* river routing. Muskingum method (02/21/23).
- 6.b) Derivation of the one-dimensional equations of fluid motion in rivers (02/21-02/23/23).
- 6.c) *Hydraulic* river routing (02/23/23).
- 6.d) Kinematic wave model. Kinematic wave model for overland flow (02/28/23).
- 6.e) Different numerical schemes used to solve the flow equations (02/28/23).
- 6.f) Muskingum-Cunge method (03/02/23).

**7. One-dimensional models of water quality in streams.**

- 7.a) Basic equations of one-dimensional advection-diffusion (dispersion) of pollutants (03/02/23).
- 7.b) Transport models including reactive terms (03/02/23).
- 7.c) Transport models for organic matter in streams (03/07/23).
- 7.d) Transport models for suspended sediment in streams (03/07/23).
- 7.e) Transport models to assess pollution in water bodies (03/07/23).
- 7.f) Numerical schemes to deal with transport equations of the advection-diffusion type (03/09/23).

**8. Introduction to two- and three-dimensional, flow and water-quality models.**

- 8.a) Basic concepts and models most used in practice (03/09/23).
- 8.b) Description of case studies (03/09/23).
- 8.c) Shallow-water equations (03/09/23).