Course Name	Code\No.	Number of Credits			
		Theo.	Lab.	Train.	Credit
Numerical Methods in Hydrology	HWR 417	2	2	-	3
Pre-Requests	HWR 221 – HWR 231				

Course Objectives:

The goal of this course is to study the numerical methods that are related to solve the mathematical equations that describe the physical phenomenon for water resources (e.g. the movement of surface and groundwater). The reason is that to let the students estimate the parameters that control these phenomena and to study the effect of changing these parameters on the system behavior and make the simulation of the phenomena on the computer.

Course Contents:

1. The concept of modeling: Definition, types of modeling, mathematical modeling, examples of models.
2. Formulation of a mathematical model: How? Conservation laws. Example of model formulation.
3. Types of equations: Algebraic, differential, Integral, mixed, linear and non-linear equations.
4. Non-linear algebraic equations: Examples (Second order polynomial in a single variable, trial and error solution, Manning or Chezy equations, and critical depth equation).
5. Numerical integration: Trapezoid rule, Simpson rule, (Examples Calculation of water cross-section of irregular channel, backwater curve computation, average velocity, etc.).
6. Ordinary differential equations: method of finite difference, Forward Euler, Backward Euler, modified Euler methods, time stepping. (Examples, filling and empting of reservoirs, motion with non-uniform velocity, etc.).
7. System of linear equations in many variables: Method of matrices, Jacobi method, method of elimination etc.
8. Partial differential equations: types of differential equations, finite difference solution, examples and applications (Example Laplace equation for groundwater flow).

Course outcomes:

It is expected that the student will get the following knowledge and experience:

- How to build mathematical models.
- How to Solve the mathematical models
- How to program equations no the computer using one of computer languages (Excel or Visual Basic).
- Get acquainted with many types of equations in the field of hydrology and how to solve them.

Evaluation Method:

The evaluation is performed by periodic tests, homework and requirements given to the student by the staff member.

References:

- Abbott, M.B. (1979) Computational hydraulics. Pitman Publishing Limited.
- Carnaahan, B , Wther, H.A. and Wilkes J.O. (1969). Applied numerical methods. J. Wiley & Sons.
- Chow, V.T., Maidment, D.R. and May, L.W.(1988) Applied hydrology, McGraw Hill Book Company.
- Hornbeck, R.W. (1975). Numerical method. Quantum Publishing, Inc.
- Streeter, V. and Wylie, E.B.(1979) Fluid mechanics, McGraw Hill Book Company.
- Wang, H. and Anderson, M. (1982) Introduction to groundwater modeling finite difference and finite element methods, Freeman and company.
- **Middleton, G.V.** (2004). Data Analysis in the Earth Sciences Using MATLAB, ISBN: 0-13-393505-1
- **Moler, C.** (2004). Numerical Computing with MATLAB, Electronic edition: The MathWorks, Inc., Natick, MA, 2004. http://www.mathworks.com/moler; Print edition: SIAM, Philadelphia, 2004.