Hydrology, Water and Environmental Engineering Laboratory

1. **Course number and name:** 020HYDGS5 Hydrology, Water and Environmental Engineering Laboratory

2. **Credits and contact hours:** 4 ECTS credits, 2x1.25 hours

3. **Name(s) of instructor(s) or course coordinator(s):** Renalda EL-SAMRA

4. **Instructional Materials:**

   a. Class notes by Renalda EL-SAMRA

   b. Chow, V., Maidment, D. R., & Mays, L. W. (1988). *Applied Hydrology*. McGraw-Hill.

   c. Bedient, P. B. & Huber, W. C. (2002). *Hydrology and Floodplain Analysis*. Prentice Hall

   d. Bras, R. L. (1990). *Hydrology: An Introduction to Hydrologic Science*. Addison-Wesley Publishing Company

5. **Specific course information**
   - **a. Catalog description:** This course consists of two parts: climatology and hydrology. Climatology deals with the atmospheric mechanisms as well as qualitative and quantitative climate parameters. Hydrology is a fairly large field that covers measurements of a significant number of hydrological variables, as well as the analysis and quantification of terms related to conservation principles. Also, this part deals with extreme events and sheds light on hydrological modeling.

   - **b. Prerequisites or co-requisites:** 020HYDGS3 Hydraulics

   - **c. Required:** Required course for Water and Environmental Specialty students.

6. **Educational objectives for the course**
   - **a. Specific outcomes of instruction:**
     By the end of the course, the student will be able to:
     - Understand and interpret climate phenomena, and apply quantitative techniques that are associated with their estimation
     - Analyze and study hydrological conservation principles by identifying and evaluating the terms of the mass balance sheet within their physical context
     - Estimate extreme hydrological events
     - Approach general hydrological modeling with simple particular applications

b. **PI addressed by the course:**

PI	1.4	2.1	3.2
Covered	yes	yes	yes
Assessed			

7. **Brief list of topics to be covered:**

a. **Introduction to climatology and hydrology (1 h 15)**
Basic concepts, historical overview, water cycle, water residence time in major reservoirs, atmospheric composition, atmospheric humidity and corresponding formulations.

b. **Solar radiation and the Earth's Energy Balance (2 h 30)**
Atmospheric energy balance, elements of atmospheric thermodynamics, elements of atmospheric mechanics, hydrostatic equilibrium of the atmosphere, atmospheric stability, vertical structure of the atmosphere, variations in pressure and pressure field.

c. **Principles of Meteorology: The Earth-Atmosphere System (1 h 15)**
Geostrophic and gradient types of wind, atmospheric boundary layer, local effects of wind, general atmospheric circulation, meridional and horizontal circulation

d. **Rainfall Analysis (2 h 30)**
Rainfall formation, rainfall operational aspects, rainfall structure and development, various types of precipitation, rainfall data monitoring, point rainfall statistical study, average rainfall over a basin, rainfall coefficient, rainfall regimes.

e. **Evaporation and Transpiration (2 h 30)**
Evaporation and evapotranspiration, expression of potential evapotranspiration from the energy balance sheet, physically and empirically based formulas, real evapotranspiration (ETR)

f. **Flow in Unsaturated Media and Infiltration (2 h 30)**
Process description, factors of influence, net rain, effective rain, study of the phenomenon on the microscopic scale in both agronomic and hydrological contexts, various models of infiltration calculation.

g. **Surface Water (3 h 45)**
Sources of streamflow, the hydrograph, excess rainfall and direct runoff, SCS method, flow depth and velocity, travel time

h. **Hydrographic Study (3 h 45)**
Hydrogram for long-term uniform rainfall, rainwater distribution during rainfall events and different types of flow, transformation from rainfall into flood hydrograph, hydrograph form, floods, factors of influence of the hydrological response, method of the unit hydrograph, rational method

i. **Lumped Flood Routing (2 h 30)**
Lumped system routing, Runge-Kutta method, Hydrologic river routing, linear reservoir model

j. **Distributed Flood Routing (2 h 30)**
Saint-Venant Equations, classification of distributed routing models, wave motion, kinematic wave approximation, finite difference method, Muskingum-Cunge method

k. **Short Overview on Modeling (2 h 30)**

General concepts, conceptual models, models GR3j, CREC, "black box" models, model neuro-flow: criteria for model validation, design of a two-reservoir model

l. Laboratory experiments (2 h)

Hydrology bench, solid transport bench and water treatment bench