FOREST AND WETLAND HYDROLOGY

NRC 528, 3 credits, Fall 2011
(offered alternate years)
SPIRE #: 37785
305 Holdsworth Hall, TTh, 11:15-12:30

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Summary – This course focuses on water movement through forest and wetland ecosystems. The water balance and energy balance are used as the analytical framework for the exploration of hydrologic processes. The effects of land and natural resource use on the quantity, timing, and quality of water flow—and consequent watershed management challenges and opportunities—are also presented and discussed.

Required Text – Brooks, K.N., P.F. Ffolliott, H.M. Gregersen, and L.F. DeBano. 2003. *Hydrology and the Management of Watersheds*. 3rd Edition, Iowa State University Press, Ames, 574 pp.

Optional Text – de la Crétaz, A.L., and P.K. Barten., 2007. *Land Use Effects on Streamflow and Water Quality in the Northeastern United States*. CRC Press/Taylor & Francis Group, Boca Raton, FL, 319 pp.

Preparation and Expectations

Graduate and upper division undergraduate students from a wide range of academic backgrounds and interests (e.g., forestry, wildlife ecology, fisheries, civil and environmental engineering, landscape architecture, plant and soil science, and geosciences) have successfully completed this 500-level physical and ecological science course. An interdisciplinary subject should attract a diverse class.

Lectures and problem sets are based on the minimum expectation that students have completed college-level mathematics (pre-calculus), basic statistics, biology, and chemistry (or their equivalents) and are able to use Microsoft Excel for graphing and calculations.

Because of the interdisciplinary nature of hydrology, training in forest ecology, geology, physics, and soil science are helpful. Part 1 of the optional text provides background information on hydrology, environmental chemistry, aquatic ecology, and riparian areas that will be helpful to students with a strong interest in the course that also need additional preparation. It is the required text for ECO 697LU: Land Use and Watershed Management (Fall 2012).

Here is the entire course (missing a few hundred salient details) on one page[1]

Law of Conservation of Mass and Energy: $\Sigma Inflows - \Sigma Outflows \pm \Delta Storage = 0$

Water Balance Equation: $P - ET - Q \pm \Delta S = 0$

P = precipitation, ET = evapotranspiration, Q = water yield, S = storage

$$P - (E + T + I) - (Q_{OF} + Q_{SSF} + Q_{GW}) \pm \Delta (S_{SNOW} + S_{SOIL} + S_{WETLANDS} + S_{LAKES} + S_{STREAMS} + S_{BIOMASS}) = 0$$

Water Balance = *ƒ* (Energy Balance, time, terrain, land use, legacy effects, climate, etc., etc.)

[1] A "water year" (beginning and ending in March) starting from the upper left and proceeding, typewriter fashion, to the lower right, 365 days later — looking from forested uplands across a wetland to an open field about 200 meters away.

Lecture and Discussion Topics	Reading (chapters)
Introduction Review of syllabus and overview of the course	1
Precipitation and Interception Formation, forms, frequency-intensity-duration, wet and dry deposition, ecological significance	2
Soil physical and hydraulic properties Texture, structure, density, porosity, permeability, Darcy's Law saturated and unsaturated flow	3, 4, 5
Energy exchange Radiant energy, surface characteristics, reflection, absorption, transmission, diurnal and seasonal patterns	handout
Snow accumulation and melt Physical properties, radiative transfer, metamorphism	15
Upland evapotranspiration Soil-plant-atmosphere continuum, water use efficiency, physiological regulation, field experiments	3
Streamflow generation Pathways of flow, variable source area concept	4, 5, 6
Wetlands Physical and hydraulic properties of hydric soils, flow routing, interconnection with groundwater systems (recharge and discharge)	14
Surface and mass erosion Raindrop splash, sheet, rill, and gully erosion, slope stability, Sediment delivery, prediction methods	7, 8
Riparian areas Delineation, structure and function, woody debris, management	13
Open channel flow Energy status of flow, water surface profiles, Manning's equation	9, 10
Hydrologic impacts of land use Historical patterns and trends, legacy effects, thresholds and signals	11, 12, handouts

Problem Sets	%
1. Soil water storage and movement	10
2. Water Balance spreadsheet (from NOAA and USGS data)	50
3. Open channel flow – Manning's equation	15
4. Hydrologic effects of land use (Harvard Forest Models)	25

Problem sets are due in class on the date indicated. All students must complete the full complement of problem sets and exams. Reasonable exceptions will be made for illness or family emergencies. You should start to work on the problem set when it is received and take advantage of opportunities to ask questions in class and to seek help during office hours (or by email).

Take Home Exams – There will be three take home exams. They are comprised of short essay questions with one week allotted to write the exam. The primary purpose of these exams is to foster integration and synthesis of key concepts and information. I expect you to do well on these exams (with the proviso that you start to work on them when they are distributed and that you carefully fact-check, edit, and proof-read your responses before they are submitted. I am happy to field questions in class or my office.

Course Grade = 0.7 (exam average) + 0.3 (problem set total)

Letter grade	Point total
A	>92.5
A-	90 – 92.4
B+	87.5 – 89.9
B	82.5 – 87.4
B-	80 – 82.4
C+	77.5 – 79.9
C	72.5 – 77.4
C-	70 – 72.4
D	60 – 69.9
F	<60

Most students *earn* an A or B.

Incomplete Policy – An incomplete (INC) will be submitted if, and only if, the student has a documented medical absence or family emergency during the semester as described in the UMassAmherst attendance policy. In all other cases, the course grade will be calculated as noted above from the work that has been submitted by the last due date. (http://www.umass.edu/registrar/registration/academic_regulations.htm).

Statement on Academic Honesty – Each student must meet the class requirements (take-home exams and problem sets) by doing their own work. Any form of cheating on exams or problem sets (e.g., submitting a copy of someone else's spreadsheet) will result in an F for the course (not just for the work in question). UMassAmherst policies and adjudication and appeal procedures can be found at www.umass.edu. This is *NOT* a prohibition on working and learning together with fellow students. It is simply a reminder that all submitted work must be your own (with appropriate attribution of reference material and data sources, etc.).

Date	#	Lecture/Discussion Topic	Exam
6 Sept	1	Introduction and Overview of the Course	1
8 Sept	2	Precipitation and Interception	1
13 Sept	3	Precipitation and Interception	1
15 Sept	4	Soil water storage and flow	1
20 Sept	-	**No Class** – presenter at Maine WR Conf., Augusta	1
22 Sept	5	Soil water storage and flow	1
27 Sept	6	Soil water storage and flow	1
29 Sept	7	Energy Balance	1
4 Oct	8	Energy Balance and Snow	1
6 Oct	9	Snow	1
11 Oct	-	**No class** …Monday schedule at UMassAmherst	-
13 Oct	10	Evapotranspiration	2
18 Oct	11	Evapotranspiration	2
20 Oct	12	Water Yield (Streamflow and Groundwater recharge)	2
25 Oct	13	Water Yield (Streamflow and Groundwater recharge)	2
27 Oct	14	Frequency analyses	2
1 Nov	15	Wetlands	2
3 Nov	16	Wetlands	2
8 Nov	17	Wetlands	2
10 Nov	18	Surface and Mass Erosion	3
15 Nov	19	Surface and Mass Erosion	3
17 Nov	20	Riparian Areas	3
22 Nov	21	Open Channel Flow	3
24 Nov	-	**No class**, Thanksgiving Recess	-
29 Nov	22	Open Channel Flow	3
1 Dec	23	Dynamic Equilibrium	3
6 Dec	24	Land Use Effects (PS 4 checklists started)	3
8 Dec	25	Land Use Effects (PS 4 checklists completed)	3
17 Dec	-	Last date to submit Exam 3 and Problem Set 4.	-