**GEOG 441-001 – 3 units**
**Introduction to Watershed Systems**
**Spring 2019**

Schedule: Lecture: MWF 12:20 – 1:10 p.m. Room: Carolina Hall 204

## INSTRUCTOR:

Andrew Murray
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Email: amurray@live.unc.edu
Office Hours: W/Th 11:00 – 12:00, or by appointment

**About me (your instructor):** I am a Ph.D. student here in the department of Geography. Before this, I earned my bachelors and Masters degrees in Geography from the University of Cincinnati in 2012 and 2015 respectively. From 2015 through 2017, I worked at the U.S. Environmental Protection Agency Office of Research and Development in Cincinnati where I focused on the impacts of leaking gas tanks on drinking water. My focus now is on the impacts of extreme precipitation on groundwater vulnerability to contamination. I do a lot of my work utilizing geospatial analysis and I like to code a lot in R. I'm also really into data visualization and science communication. I also like talking about all of these things!

## COURSE CONTENT:

This course is an introduction to hydrologic and geomorphic processes and forms in watersheds as applied to water quality, the biophysical dimensions of water, and interactions and feedbacks between water, climate, landscape morphology, vegetation cover, and soil processes. Hydrology is the study of the occurrence and movement of water on and beneath the surface of the Earth, and the interactions of water with biotic and abiotic variables in the environment. This course will cover the structure of drainage networks, nested catchments, and distribution and controls of precipitation, evaporation, runoff, soil moisture, and groundwater flow.

The course is necessarily quantitative in its focus on water budget and transport processes and students are expected to be conversant and comfortable with basic computer usage (e.g. spread sheets, other applications). GEOG110, ENST 202 or a similar introductory environmental science course is a prerequisite. A prior course in GIS is useful, but not essential.

Following this course, students will:

- Be competent in discussing and applying the basic concepts of watershed hydrology, hydrologic processes, and watershed systems, and will have a basic understanding of the earth's hydrologic cycle and its components.
- Be proficient in analyzing hydrologic data using many of the standard methods used within the discipline of hydrology.
- Be knowledgeable of fundamental interactions between water, climate, ecology, geomorphology, and the role of water as the universal solvent.
- Be knowledgeable in applying fundamental hydrologic principles in water resources management.

**METHOD:**

The course is taught in a lecture format with weekly assignments and/or readings.

**TEXTBOOK AND READINGS:**

1. *Elements of Physical Hydrology*, G.M. Hornberger, P.L. Wiberg, J.P. Raffensperger, and P. D'Odorico, 2014, 2nd Edition. John Hopkins University Press.
2. *Challenges and Opportunities in the Hydrologic Sciences*, Hornberger et al., (2012), Report by the National Research Council of the National Academies.
3. *Urban Stormwater Protection in the United States***,** Welty et al., (2008) Report by the National Research Council of the National Academies. http://www.epa.gov/npdes/pubs/nrc_stormwaterreport.pdf
4. *There will be additional readings, including 15-20 articles of recent peer-reviewed literature.*

**SYLLABUS CHANGES**

The professor reserves to right to make changes and adjustments to the syllabus, including project due dates and test dates, when unforeseen circumstances occur. These changes will be announced as early as possible so that students can modify their schedules.

**HOMEWORK:**

Homework assignments will be given to provide students with experience solving practical, **quantitative** problems in hydrology and as preparation for problems on the exams.

**Graduate Students:** Graduate students who are enrolled in the course will be required to complete an additional assignment to be computed as homework. The assignment will consist of a class presentation/report of her/his own research project findings or research proposal, especially placed in the context of topics previously discussed in class. Presentations must adhere to the requirements **professional seminar** presentations. The objectives of this additional assignment are 1) to exemplify how topics previously discussed in class are associated with a broad range of research projects and subjects outside the classroom; 2) to foster public speaking in the graduate student – a skill required in any professional field; and 3) to promote the graduate student's ability to convey her/his scientific expertise in a way that is understandable to educated but not expert audiences. If the student does not have a relevant research project, a review seminar on a topic to be agreed upon with the class instructor will be presented.

**GRADING:**

| | |
|---|---|
| Graded Homework | 30 |
| Mid-term Exams (2) | 30 |
| Final Exam (1) | 30 |
| Class Participation | 10 |
| | 100 |

A (94-100%); A- (90-93);
B+ (87-89); B (83-86); B- (80-82);
C+ (77-79); C (73-76); C- (70-72);
D+ (67-69); D (63-66); D- (60-62);
F (<60).

Class participation is expected (10% of grade) and will be derived from pop quizzes and active participation in class. Missed examinations must be cleared with the instructor **ahead of time**. No make-up exams will be given to students that have not notified the instructor ahead of the absence.

**HOMEWORK:**

In general, homework will be quantitative exercises where you will be expected to complete analyses and problems related to the present material. Some of these homework will be exercises in R where as others might be reading a journal article and writing an annotation (think of this as synthesizing the article in your own words).
Due dates will be given out in advance on homework and reports. **NO LATE HOMEWORK WILL BE ALLOWED.** Special circumstances regarding homework deadlines must be arranged with the instructor as far in advance as possible. All work should be well organized and neat. Spelling and grammar will be considered in grading reports. Since a significant portion of the course grade is based on class participation and graded homework and reports, students should place priority on timely preparation of high quality homework and be active participants in class.

Please turn off your cell phone during class.

**ATTENDANCE POLICY:**

This course will adhere to UNC's Class Attendance Policy, found at https://catalog.unc.edu/policies-procedures/attendance-grading-examination/. Students are responsible for the material presented in lecture or laboratory periods. It is your responsibility to acquire lecture notes, handouts or exercises for missed class periods. Each student will be allowed 3 unexcused absences for the semester, after which you will lose 1 point from your participation grade (1% of the final grade for the course) for each missed class. For excused absences, a student should present his or her explanation in writing to the professor in advance if the reason for the absence could be foreseen, or as soon as possible thereafter if the reason for the absence could not be foreseen.

**HONOR CODE:**

The University of North Carolina at Chapel Hill has had a student-led honor system for over 100 years. Academic integrity is at the heart of Carolina and we all are responsible for upholding the ideals of honor and integrity. The student-led Honor System is responsible for adjudicating any suspected violations of the Honor Code and all suspected instances of academic dishonesty will be reported to the honor system. Information, including your responsibilities as a student is outlined in the Instrument of Student Judicial Governance. Your full participation and observance of the Honor Code is expected.

Plagiarism in the form of 'deliberate' or 'reckless' representation of another's words, thoughts, or ideas as one's own without attribution in connection with submission of academic work, will not be tolerated and may be considered academic misconduct. For additional information, please contact the professor or the Office of Student Conduct at 919-962-0805.

**TENTATIVE COURSE OUTLINE FOR SPRING 2015:**

| WEEK | TOPIC | READING (Elements of Phys. Hydrol. unless otherwise noted) | NOTES |
|---|---|---|---|
| 1 | Introduction to the class. The Global Water Crisis | | Course begins Jan 8 |
| 2 | Water Cycle & Water Balance Equation | Chapter 1 | |
| 3 | Dimensional Analysis. The Watershed Concept | Appendix A1, Chapter 2 | Jan 20: Holiday – no class |
| 4 | Land-atmosphere interactions | Chapter 2 | |
| 5 | Radiation and Energy Balance | Class notes and slides | EXAM 1 on Feb 7 |
| 6 | Soil hydrology and the unsaturated zone, Principles of Fluid Dynamics | Chapters 8 and 3 | |
| 7 | Hillslope Hydrology Groundwater Hydrology | Chapters 9, 6 & 7 | |
| 8 | Groundwater Hydrology | Chapters 6 & 7 | |
| 9 | Streams and Floods | Chapter 5 | EXAM 2: Mar 6 |
| March 9-13 | Spring Break | Spring Break | Spring Break |
| 11 | Principles of Ecohydrology, plant-water interactions | | |
| 12 | Land Use Change Hydrology | | |
| 13 | Watershed Management | Rodriguez et al., 2013; Cole et al., 1994; Guerin et al., 2006; Barros et al., 2011. Licker et al., 2010; Foley et al., 2011; Mueller et al., 2012 | No Class April 10: University holiday. |
| 14 | Watershed Markets & Water Funds | Porras et al., 2013 (pp 7-10). Redford & Adams, 2009: Brouwer et al 2011; Murphy et al; Zheng et al., 2013; Soares et al., 2006; Asner et al., 2011 | |

| WEEK | TOPIC | READING (Elements of Phys. Hydrol. unless otherwise noted) | NOTES |
|---|---|---|---|
| 15 | Graduate student presentations, or guest lecturers TBD | | |
| 16 | Graduate student presentations, or guest lecturers TBD | | Course ends April 24 |
| | FINAL EXAM | Comprehensive Final Exam | Monday April 27, 12:00p.m. |