Title of the course: **Water Resources Systems**
Course Instructor: Dr. Geetha Mohan and Dr. Saroj Chapagain

Course description:
Rapid population growth, changes in lifestyle, climate, landuse etc. have made sustainable management of water resources a very complex task. This course aims to provide a broad understanding of the hydrological processes, global environment changes and how they are related to sustainability of water resources systems. This course will introduce the characteristics of major components of water cycle; rainfall, groundwater flow, water sanitation, and the role of remote sensing, GIS, risk analysis, role of water resource planning, climate projections, development impacts and economic analysis in understanding and managing water resources systems. The course will also examine various issues related to water resources and sustainability through case studies and field visit.

Learning Outcome:
The students will gain a comprehensive overview of water and its relation to human and environmental well-being. The students will be able to understand water related issues and tools to manage water-related problems.

Topics covered

Day 1: Introduction of water resources systems
Elements of a water system, concept of a system (basin); water budget
Day 2: Water resources sustainability
Concept, challenges (urbanization, hydro-meteorological extremes, land-use changes)
Day 3: Groundwater
Aquifer properties; groundwater movement; Darcy's law; well hydraulics
Day 4: Groundwater contamination
Groundwater quality, point source, non-point source contamination
Day5: Water sanitation
Basic environmental sanitation and impact on water resource
Day 6: Remote Sensing and GIS applications
Sensors; image processing; online data sources; watershed delineation; use of ArcGIS software
Day 7 & 8: Economic analysis of water resources
Cost-Benefit analysis, crop production functions with water, risk analysis
Day 9: Water resource planning for a sustainable society
The meaning of sustainability, role of water resource planning, case studies
Day 10: Written examination
Day 11: Field visit
Day 12: Climate change and water resources
Concept, climate projections, climate change impact studies
Day 13 &14: Development impacts of improved water resources management
Social impacts, economic impacts, and environmental impacts
Day 15: Report/Presentation by students

Assessment Criteria:
Assessment will be based on class attendance, presentation and discussion, a short final test and extended essay with the following allocations;

- Attendance: 20 %
- Assignments: 40 %
- Written examination: 20%
- Final presentation: 20%

Reading materials:

- Water Resources Engineering by Larry W. Mays, John Wiley & Sons, 2nd Edition, 2010.
- Applied Hydrology by Ven Te Chow, David R. Maidment, Larry W. Mays, McGraw-Hill Publishing Company; International edition (1988/09).
- IPCC AR5 WG 2 Summary report for policy makers, 2014.
- World Water Assessment Programme (2009): The United Nations World Water Development Report 3. Water in a Changing World, UNESCO, Part 1 (Ch. 1, 3, 5), Part 2(Ch. 7, 8), Part 3(Ch. 10,11)
- Water Evaluation and Planning System (2012): A collection of stand-alone modules to aid in learning the WEAP software (http://www.weap21.org/index.asp?action=213)
- Remote sensing and GIS for Water Resources Management, Version 2, IIT, Kharagpur (http://nptel.ac.in/courses/105105110/pdf/m6l03.pdf)
- Example of the use of CropWat 8.0
- (http://www.fao.org/nr/water/docs/CROPWAT8.0Example.pdf)
- FAO Irrigation and Drainage Paper No. 56, 1998. Crop Evapotranspiration – guidelines for computing crop water requirements
- Daene C. McKineey (2013): Chapter 2. Economic Analysis of Water Resources, http://www.caee.utexas.edu/prof/mckinney/ce385d/Papers/EconNotes.pdf