

Title of the course: **Water Resources Systems**

Course Instructor: Dr. Binaya Kumar Mishra

**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, unsaturated zone flow, surface runoff, river flows and the role of remote sensing, GIS, statistical techniques, and simulation models 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; climate change)*

Day 3 & 4: Acquisition and processing of water resources data

*Precipitation, streamflow, stage-discharge relationship*

Day 5: Remote Sensing and GIS applications

*Sensors; image processing; online data sources; watershed delineation; use of ArcGIS software*

Day 6: Groundwater

*Aquifer properties; Groundwater movement; Darcy's law; well hydraulics*

Day 7: Unsaturated zone

*Soil root zone; unsaturated zone flow; infiltration process*

Day 8: Surface runoff

*Rainfall-runoff process; hydrograph; flow routing; use of hydrologic model*

Day 9: Statistical techniques

*Distribution functions, frequency analysis; Risk analysis*

Day 10: Written examination

Day 11: Field visit

Day 12: Climate change and water resources

*Concept, Climate projections, impact studies*

Day 13 & 14: Sustainable water resources management strategies

*IWRM; infiltration measures; economic analysis; optimization, case studies*

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/m6103.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