Course title: Water resource systems and interactions

Course code: WSW 165	**No. of credits** 5	**L-T-P:** 4-1-0

Pre-requisite of the course (if any): None

Course Description

The course serves as a foundation course and will help a student to comprehend concepts in other courses from a system perspective. It introduces principal components of water resources systems, their functioning; basic hydraulics, the hydrological cycle; interaction between water and environment; elements of water systems and their interactions vis-à-vis water use – agriculture, water supply, industry and nexus between water and resources such as food, energy, economy etc.

Course objectives

Provide knowledge of global distribution of water resources, water systems and their interactions and appreciate some of the potential impacts of population, global climatic change and development activities on water resources and vice-versa.

Course content

Module	**Topics**	**L**	**T**	**P**
1.	**Introduction:** models and systems; input-output analysis, river and drainage basin; basic hydrology; flow in rivers: transport, erosion and deposition; river profile; channel patterns; basic understanding of water systems:- river, ground water; ponds, lakes and reservoirs features of natural ecosystems- marine, glaciated, desert, tropical, coastal, forest, grasslands.	12		
2.	**Basic Hydraulics** Water pressure; pressure-velocity-head relationships; energy and momentum equations; flow in pipes; equivalent pipe; open channel flow; flow measurement in pipes and open channel; centrifugal pump characteristics; system characteristics; head loss constants in open channels and pressure pipes; Flow in open channels and non-uniform flow in open channels.	16	12	
3.	**Water - environment interaction** (a) *Water and climate:* global atmospheric and ocean circulation, meteorology, stability and instability of air masses, humidity and precipitation, air masses and frontogenesis, types and distribution of precipitation; monsoon and jet streams; mechanism of Indian monsoon and rainfall pattern (spatial and temporal); southern ocean circulation and influence on monsoon; cyclones, floods and draughts; global climate change and influence on precipitation. (b) *Water and soil:* classification and distribution of soil, water and soil characteristics; soil and water availability. (c) *Water and vegetation:* factors influencing distribution of plants and animals; adaptation; problems of degradation and	8 4 4		

	conservation measures.			
	Water and development (a) *Water and food:* marine food resources; from green revolution to sustainable agriculture and infrastructure,- irrigation, seeds, fertiliser, power; impact of changing cropping pattern on water resources; agriculture intensity and land capability. *(b) Water and energy:* Water for energy - waves, current and tides; hydro; thermal; Energy for water- urban, agriculture and industry. *(c) Population, human settlement and water use:* growth and distribution of world population, concept of over-under and optimum population; regional planning and planning for sustainable habitat; types of human settlement vis-a vis water usage and pollution, sanitation and health. (d) *Water and industry:* Water intensive industries, industrial pollution and impact on water resources	5 3 5 2		
		59	**12**	

Evaluation criteria

- 2 minor tests 20% each
- Assignments 10%
- Major 50%

Learning outcomes

1. describe the major components of the hydrological cycle, and understand the interactions within the system and across;
2. predict for a given water resource system various processes and how these processes are dynamically linked with aquatic ecosystems as well as with human activities;
3. explain the key concepts for integrated, multidisciplinary and interdisciplinary analyses of water resources;
4. reckon value of water for various uses and users and explain how these concepts can be used in water resources planning at various spatial and temporal scales.

Pedagogical approach

Classroom teaching will involve black board, power point presentations, and case study analysis. The sessions will be interactive and students will be expected to make presentations on specific research topics.

Materials

1. Loucks, D.P., J.R. Stedinger, and D. A. Haith, (1981) *Water Resource Systems Planning and Analysis*, Englewood Cliffs, NJ, Prentice Hall.
2. Cengel, Y.A., and J.M. Cimbala, (2010) Fluid Mechanics: Fundamental and Applications, Tata McGraw Hill.
3. Simonvic, S.P. (2009) Managing water resources: Methods and tools for a system approach, UNESCO Publishing, France.

4. Loucks, D.P. and J.S. Gladwell, (1999) *Sustainability Criteria for Water Resource Systems*, Cambridge, UK, Cambridge University Press.
5. Chorley, R. J. 1969. Water, earth and man: a synthesis of hydrology, geomorphology and socio-economic geography. London: Methuen young books.
6. Ehrlich, P.R., Holdren, J.P., and Ehrlich A. H.1978. Ecoscience: population, resources, environment, 3rd ed. San Franscisco: W.H. Freeman.
7. OUP. 2010. Oxford Reference Atlas for India and the World. New Delhi: Oxford university press
8. Shaw E. M. (1994) Hydrology in Practice (3rd Edition), Chapman & Hall, London,

Additional information (if any)

Student responsibilities

The nature of the course demands that the students shall attend all lectures and have the habit of identifying and reading open e-learning resources.

Course Reviewers:

1. Prof Narender Kanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.
2. Mr Sundeep Singh, Sr Environmental Engineer (Scientist-D), CPCB, India.