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Department of Civil Engineering	
Water Resources Management (61676)	
Total Credits	**3**
major elective	
Prerequisites	P1 : Hydrology (61441)

Course Contents

Importance of management. Elements of water resources. Components of water resources management. Spatial and temporal scales of water resources management. Concepts and methods of optimization including linear programming and integer programming with emphasis on graphical, analytical, and computer solutions. Optimal design of water distribution networks. Groundwater management and the use of lumped parameter models. Surface water management including reservoir operation. Artificial groundwater recharge. Multi-criteria decision analysis. The impact of climate change on water resources. Unconventional Water Resources. Software applications in linear and integer programming.

	Intended Learning Outcomes (ILO's)	Student Outcomes (SO's)	Contribution
1	Ability to define and describe selected water resources management problems	A E K	15 %
2	Ability to formulate optimization modules and the ability to solve these modules	C E K	30 %
3	Ability to understand and apply water resources management techniques to different water resources systems including water networks, groundwater, surface water and water quality issues	C E G I J	30 %
4	Ability to apply water evaluation and water planning tools such as the WEAP model	A D E G	10 %
5	Ability to apply the principles of water resources management to real life problems including wastewater collection treatment and reuse and to solid waste management problems.	A C E K	15 %

Textbook and/ or Refrences

Course notes in the form of power point presentations suffice to cover the material. Students are encouraged to consult the following texts: Water Resources Systems Planning and Management: An Introduction to Methods, Models, and Applications. D. P. Loucks and E. Van Beek. UNESCO Publications, 2005. Water Resources Management: Principles, Regulations, and Cases. N. S. Crigg. McGraw-Hill, 1996. Principles of Water Resources History, Development, Management, and Policy. Thomas V. Cech. John Wiley and Sons, Inc, 2003.

Assessment Criteria	Percent (%)
First Exam	20 %
Second Exam	20 %
Projects	10 %
Final Exam	50 %

Course Plan

Week	Topic
1	General introduction Course overview Importance of management Elements of water resources Components of water resources management Spatial and temporal scales of

	water resources management
2 &3	Optimization Introduction Concepts and methods Linear programming (LP) LP graphical, analytical, and computer solutions
4 &5	Water distribution networks Theoretical background Optimal network design
6, 7 &8	Groundwater management Theoretical background Lumped parameter models Simple applications of LP in groundwater management
9	Surface water management Reservoir operation Artificial recharge
10 &11	Integer programming Concept Applications
12	Multi-Criteria Decision Analysis Concept Applications
13	The Impact of Climate Change on Groundwater and Drought Management
14 &15	Demand Management Using WEAP