

Water Resources Systems : Modeling Techniques and Analysis - Video course

COURSE OUTLINE

Course Description: The course introduces the concepts of systems techniques in water resources planning and management.

Course Contents

Introduction – Concepts of Systems and Systems Analysis; Systems Techniques in Water Resources : Optimization with methods using calculus; Linear Programming; Dynamic Programming; Simulation; Combination of Simulation and Optimization; Multi-objective Planning. Economic Considerations in Water Resources Planning; Reservoir Systems – Deterministic Inflow : Reservoir Sizing; Reservoir Operation – standard operating policy, optimal operating policy; multi-reservoir systems; Reservoir Systems – Random Inflow : Chance Constrained Linear Programming; Concept of Reliability; Stochastic Dynamic Programming; Applications – Reservoir systems operated for Irrigation, Hydropower, Flood Control and Municipal and Industrial Supplies; Water Quality Control in River Systems; Case Studies; Recent Modeling Tools – Artificial Neural networks, Fuzzy Inference Systems; Fuzzy Linear Programming;

COURSE DETAIL

Module 1	Introduction and Optimization
Lecture-1	Introduction
Lecture-2	Definitions and types of systems
Lecture-3	Optimization: Functions of a single variable
Lecture-4	Optimization: Functions of multiple variables
Lecture-5	Constrained optimization (1)
Lecture-6	Constrained optimization (2)
Lecture-7	Kuhn-Tucker conditions and Introduction to Linear Programming
Module 2	Linear Programming
Lecture-8	Linear Programming: Graphical method
Lecture-9	Linear Programming: Simplex method (1)
Lecture-10	Linear Programming: Simplex method (2)
Lecture-11	Linear Programming: Multiple solutions
Lecture-12	Linear Programming: Unbounded and infeasible problems
Lecture-13	Linear Programming: Dual problem
Module 3	Dynamic Programming
Lecture-14	Introduction to Dynamic Programming

NPTEL

<http://nptel.iitm.ac.in>

Civil Engineering

Pre-requisites:

- A preliminary background in surface water hydrology is desired, but not essential.

Additional Reading:

1. Jain, S.K. and Singh V. P. (2003) Water Resources Systems Planning and Management, Elsevier.
2. Chaturvedi M C (1987) Water Resources Systems Planning and Management, Tata McGraw Hill, New Delhi.

Hyperlinks:

- <http://www.eolss.net/Sample-Chapters/C07/E2-16-03-01.pdf>
- <http://www.sciencedirect.com/science/book/9780080449678>

Coordinators:

Prof. P.P. Mujumdar
Department of Civil Engineering IISc Bangalore

Lecture-15	Dynamic Programming: Water allocation problem
Lecture-16	Dynamic Programming: Reservoir operation problem
Lecture-17	Dynamic Programming: Capacity expansion and shortest route problems
Module 4	Simulation and Multi-Objective Planning
Lecture-18	Simulation: Introduction to Multi-objective planning
Lecture-19	Multi-objective planning
Module 5	Reservoir Systems – Deterministic inflows
Lecture-20	Reservoir sizing
Lecture-21	Reservoir capacity using Linear Programming (1)
Lecture-22	Reservoir capacity using Linear Programming (2)
Lecture-23	Reservoir operation
Lecture-24	Multi-reservoir systems
Lecture-25	Stationary policy using Dynamic Programming
Lecture-26	Hydropower generation
Module 6	Reservoir Systems – Random inflows
Lecture-27	Basic probability theory (1)
Lecture-28	Basic probability theory (2)
Lecture-29	Chance constrained Linear Programming for reservoir operation and design (1)
Lecture-30	Chance constrained Linear Programming for reservoir operation and design (2)
Lecture-31	Stochastic Dynamic Programming for reservoir operation (1)
Lecture-32	Stochastic Dynamic Programming for reservoir operation (2)
Lecture-33	Stochastic Dynamic Programming for reservoir operation (3)
Module 7	Fuzzy Optimization
Lecture-34	Fuzzy optimization (1)
Lecture-35	Fuzzy optimization (2)
Lecture-36	Fuzzy optimization for water quality control and reservoir operation

Module 8	Model Formulations and Case Studies
Lecture-37	Conjunctive use of ground and surface water
Lecture-38	Hydropower optimization
Lecture-39	Crop yield optimization
Lecture-40	Multi-basin and multi-reservoir systems

References:

1. Loucks, D. P. and Elco Van Beek (2005) Water Resources Systems Planning and Management : An Introduction to Methods, Models and Applications., UNESCO, Netherlands.
2. Vedula, S. and Mujumdar, P. P. (2005) Water Resources Systems : Modelling Techniques and Analysis, Tata McGraw Hill, New Delhi.
3. Mays L.W and Tung Y-K, (1992) Hydrosystems Engineering and Management, McGraw Hill, USA.
4. Simonovic, S. P. (2009) Managing Water Resources : Methods and Tools for a Systems Approach, UNESCO Publishing, France.