Course title: Optimization techniques for water management			
Course code: WSW 173	**No. of credits:** 4	**LTP distribution:** 42-17-0	**Learning hours:** 59
Pre-requisite course code and title (if any): None			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr. Sherly M.A.		**Course instructors(s):** Dr. Sherly M.A.	
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Course type: Compulsory Core		**Course offered in:** Semester 2	

Course Description

Water demand management involves decision making on allocation of water effectively and efficiently amongst various equally important sectors. This is done by using a number of optimization techniques which are applicable for different range of challenges in water demands which are likely to increase in future. The course offers exposure to optimization techniques which will help in multipurpose reservoir operation for hydro power, flood control and irrigation, river water quality, water supply and drainage network optimization amongst others. Course will explore recent developments in the field with case studies and benefits of using such techniques for satisfying water demands through optimum resources allocation.

Course objectives

- Introduce students to water demand management concepts
- Use techniques to assess water demand for various sectors
- Examine various optimization techniques used for maximising allocation of water resources for satisfying water demand to various sectors
- Provide exposure to numerous problems of water demand where benefits need to be maximised and costs and efforts need to be minimised.

Course content

Module	Topic	L	T	P
1	**Introduction and basic concepts** Water demand management concepts and components, domestic, commercial, industrial, agricultural and institutional demands. Projections for future demands, additional demand management through treated waste water and maximization of use of storm water runoff. Optimization, need and its application in water demand management, challenges in water sector.	8	4	0
2	**Introduction to optimization** Problem formulation: decision variables, objective function, maxima, minima, constraints, water allocation planning process.Analysis techniques: simulation, optimization, linear programming, Lagrange multipliers, dynamic programming, integer programming multi objective programming and nonlinear programming problems, stochastic optimization	10	3	0
3	**Linear Programming (LP): Application to Water Demand Problems** Assumptions, problems formulation and solutions, graphical methods, simplex algorithm, duality concept, sensitivity analysis. Examples, reservoir for irrigation and power production, river water quality (including treated effluent component). Water supply and drainage network optimization, case study	10	4	0
4	**Dynamic programming and application** Introduction, multi stage decision problems, recursive equations, principle of optimality, discrete dynamic programming. Water allocation problem, capacity expansion problem, reservoir operation, case study	7	2	0
5	**Multi objective optimization** Introduction, non-inferior solutions, trade off analysis, weighted and constraints method, other methods, case study	7	4	0
	Total	**42**	**17**	**0**

Evaluation criteria

Minor 1	15%
Minor 2	15%
Tutorial and Quizzes	20%
Major	50%

Learning outcomes

- Students will be able to use the various optimization methods for future water demand allocation under different scenarios.
- Efficient water use to satisfy rising water demands using optimization techniques can be inherently applied by students for any irrigation, industrial cluster, municipal or watershed water distribution project.
- Real life field application challenges like reservoir water allocation for different activities like irrigation, bio diversity maintenance, and environmental flows can be addressed with knowledge of optimization methods.
- Students will be skilled so that they assess and evaluate water demand in such a way that all water resources are managed for no compromise on sustainability.

Pedagogical approach

Course shall be conducted using black board, power point presentations, MS Excel. Relevant case studies shall be discussed in class so that students are introduced to the latest stage of development in the subject. Endeavour shall be made to introduce software packages in the class through demonstrations.

Materials

Textbooks

Douglas A.H (1982) *Environmental System Optimization*, John Wiley & Sons, New York.

Vedula S. and Mujumdar P. P. (2005) *Water Resources Systems: Modeling Techniques and Analysis*, Tata MacGraw-Hill Publishing Company Limited.

Suggested Readings

Simonovic S.P.(2009)-Managing Water Resources: methods and tools for a systems approach, UNESCO publishing, France

Srinivas Raju K. and Nagesh Kumar D.,(2014)- Multicriterion Analysis in Engineering and Management, PHI Learning Pvt. Ltd., New Delhi, India

Mays L.W. and Tung, V.K.,(1992), Hydrosystems Engineering and Management, McGraw Hill, USA

Journals

American Society of Civil Engineers, Journal of Water Resources Planning
International Journal of Water Resources Development
Advances in Water Resources
The Science of the Total Environment
Environmental Modelling and Software

Student responsibilities

The course is highly technical and latest state of the art techniques shall be used, so attendance and class participation will be given utmost importance. All assignments should be submitted as per the timeline. Students will be expected to take up typical water demand problems in cities and rural areas and use optimization techniques to solve such problems.

Course reviewers

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