HWRM-303 WATER RESOURCES SYSTEM ANALYSIS (THEORY) (02 Credit hours)

PRE-REQUISITE: HWRM-204 Surface Water Hydrology

LEARNING OUTCOMES:

- This course will provide an introduction to the Water resource systems analysis as a discipline.
- The students will learn about the Classification of Mathematical Programming Models.
- They will have the knowledge about the categories of Numerical Programming Models.
- The Water Supply Problems and their possible solutions will be illustrated to them.
- The students will get used to the phenomena of Dynamic Programming.
- The students will be equipped with the various Regional water supply planning processes.

CONTENTS

Unit-1 Introduction:

1.1. Water resource systems analysis as a discipline
1.2. Linear Programming with reference to hydrology and water resources constraints
1.3. Problem statement, Problem formulation
1.4. Graphical representation of decision space
1.5. Finding the problem solution, Beyond optimality

Unit-II Classification of Mathematical Programming Models:

2.1. Linear Programming
2.2. Integer Programming
2.3. Nonlinear Programming
2.4. Static vs. Multistage Models
2.5. Deterministic vs. Stochastic Models
2.6. Solving Linear Programs by the Simplex method
2.7. Characteristics of the Simplex Algorithm

Unit-III: Category of Numerical Programming Models:

3.1. Overview of the methodology by steps
3.2. Determination of shadow prices from final table
3.3. Dealing with equality constraints
3.4. Recognizing and unbounded objective function.
3.5. Recognizing a decision variable that is nonunique
3.6. Practice LP Problem Formulation

Unit-IV: Water Supply Problem:

4.1. Problem statement,
4.2. Solution formulation,
4.3. Application of Lp to Groundwater simulation-optimization,
4.4. Water resources Network Models,
4.5. Integer Programming Nonlinear Programming,
4.6. Wastewater treatment problem revisited with nonlinear costs,
4.7. Piecewise approximations of nonlinear functions,
4.8. Lagrange multipliers, Gradient search techniques.

Unit-V: Dynamic Programming:

1.1. Mathematical Description and its Effect on Solution of Discounting Future Returns
1.2. Fuzzy Optimization,
1.3. Data-Based Optimization,
1.4. Artificial Neural Networks,
1.5. Genetic Algorithms,
1.6. Optimal Control Uncertainty and Reliability Analysis.

Unit-VI: Regional water supply planning:

6.1. River-reservoir system operation,
6.2. Water distribution system operation,
6.3. Irrigation water delivery,
6.4. Groundwater remediation,
6.5. Reservoir simulations and Multicriteria decision analysis.

ASSIGNMENTS – TYPE AND NUMBER WITH CALENDAR

It is continuous assessment. The weightage of Assignments will be 25% before and after midterm assessment. It includes:

- classroom participation,
- attendance, assignments and presentation,
- homework
- attitude and behavior,
- hands-on-activities,
- short tests, quizzes etc.

ASSESSMENT AND EXAMINATIONS:

Sr. No.	Elements	Weightage	Details
1.	Mid Term Assessment	35%	It takes place at the mid-point of the semester
2.	Formative Assessment	25%	It is continuous assessment. It includes: classroom participation, attendance, assignments and presentation, homework, attitude and behavior, hands-on-activities, short tests, quizzes etc.
3.	Final Assessment	40%	It takes place at the end of the semester. It is mostly in the form of a test, but owing to the nature of the course the teacher may assess their students based on term paper, research proposal development, field work and report writing etc.

RECOMMENDED TEXT BOOKS / SUGGESTED READINGS

1. Evangelos, B. (2018). *Hydrology and Water Resources System Analysis.* CRC Press. Taylor & Francis Group.
2. Karamouz, (2013) *Water Resources System Analysis*. LEWIS Publishers.
3. Jain & Singh. (2003) *Water Resources Systems Planning & Management*. Elsevier SAcademic Press.
4. Mays, L. (2005) *Water Resource Systems Management Tools*, McGraw Hill.
5. Hax, B. and Magnanti, (1977) *Applied Mathematical Programming*, Addison- Wesley.

HWRM-303 WATER RESOURCES SYSTEM ANALYSIS (LAB) (01 Credit hr)

PRE-REQUISITE: HYD-207 Watershed Modeling

LEARNING OUTCOMES:

- This course will provide an introduction to the Linear programming techniques for water resources system analysis.
- The students will learn about the Use of MATLAB programming software for water resources system analysis.
- They will have the knowledge about Use of R programming language for the optimization of water resources system analysis.
- The Use of different GIS/RS software's for advancement in water resources system analysis will be elaborated to the students.
- The students will be equipped with the use of any other latest software to execute programming and optimization algorithms.

CONTENTS

PRACTICAL

Unit-1

1.1. Utilization of Linear programming techniques for water resources system analysis

Unit-II

2.1. Use of MATLAB for water resources system analysis

Unit-III:

3.1. Use of R programming for optimization of water resources system analysis

Unit-IV

4.1. Use of GIS/RS software's for advancement in water resources system analysis

Unit-V:

5.1. Use of any other latest software to execute programming and optimization algorithms

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