Course Type	Course Code	Name of Course	L	T	P	Credit
DE	NCED520	Water Resources Systems Planning and Management	3	0	0	3

Course Objective
To impart knowledge on the systems analysis techniques, planning and managing water resources projects and applications to water resources planning and management.
Learning Outcomes
Students who complete this course will be able to: ● Understand the concepts involved in water resources systems planning and management. ● Know the basics of optimization, simulation and project economics. ● Understand the various applications to water resources planning and management with case studies.

Unit no.	Topics to be covered	Contact Hours	Learning outcome
1	**Water Resources Systems:** Concept of a system, types, Systems analysis techniques, Advantages and limitations of systems approach. Introduction to water resources planning, development and management, Water resources information system.	6L	Understand the concepts of water resources systems
2	**Optimization in Water Resources:** Introduction, Model formulation. Linear programming: Graphical method, simplex method, big-M method. Nonlinear programming: Unconstrained and constrained programming methods. Dynamic programming, multi-objective optimization. Simulation: Introduction, Classification of simulation models, Monte Carlo Simulation	15L	Know the basics for application of linear and nonlinear and dynamic programming in water resources.
3	**Water resources Project Economics:** Basic Principles, cash flow diagram, discount factors, discounting techniques, project feasibility and optimality. Water Resources Planning: Integrated planning, stages, formulation and screening of alternatives, Mult objective analysis.	9L	Understand the concepts of project economics, water resources planning.
4	**Systems operation and Management:** Reservoir operation-basic concepts, standard operation policies, rule curves, Integrated water resources management, decision support system. Applications to water resources planning and management, case studies.	6L	Know the basics systems operation management, applications.
5	**Hydro-power Engineering and Management**: Hydropower potential, Power supply and demand. Types and head classification of hydropower plants, Components of hydropower plants: turbines and generator, powerhouse, surge tanks and hydraulic transients, penstocks and pressure shafts. Case studies of prominent hydro-power plants.	6L	Acquire the knowledge to understand key components for efficient hydro-power generation.
	Total Contact Hours	**42L**	

Textbooks:

1. Jain, S. K. and Singh, V. P. (2003), “Water Resources Systems Planning and Management”, Elsevier.
2. Loucks, D.P., Stedinger, J.R. and Haith, D.A. (1981), “Water Resources Systems Planning and Analysis”, Prentice Hall.
3. Vedula, S. and Mujumdar, P.P. (2005), “Water Resources Systems: Modelling Techniques and Analysis”, Tata McGraw Hill.

Reference Books:

1. James, L.D., and Lee, R. R. (1971), “Economics of Water Resources Planning”, Mc Graw Hill.
2. Loucks, D. P., and E. van Beek (2005), “Water Resources Systems Planning and Management: An Introduction to Methods, Models and Applications”, U. N. Educ., Sci., and Cult. Organ., Paris. 3. Raju, K. S., Kumar, D. N. (2014), “Multicriterion Analysis in Engineering and Management”, Prentice-Hall.