Course Title: Applied Hydraulics

[As per Choice Based Credit System (CBCS) scheme]

SEMESTER – IV

Subject Code	15CV43	IA Marks	20
Number of Lecture Hours/Week	04	Exam Marks	80
Total Number of Lecture Hours	50	Exam Hours	03

CREDITS – 04

Course Objectives: The objectives of this course is to make students to learn:

1. Principles of dimensional analysis to design hydraulic models and Design of various models.
2. Design the open channels of various cross sections including design of economical sections.
3. Energy concepts of fluid in open channel, Energy dissipation, Water surface profiles at different conditions.
4. The working principles of the hydraulic machines for the given data and analyzing the performance of Turbines for various design data.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module 1: Dimensional and Model analysis	**10**	
Dimensional analysis Dimensional analysis and similitude: Dimensional homogeneity, Non Dimensional parameter, Rayleigh methods and Buckingham π theorem, dimensional analysis, choice of variables, examples on various applications.	**03**	**L1, L2, L3**
Model analysis: Model analysis, similitude, types of similarities, force ratios, similarity laws, model classification, Reynolds model, Froude's model, Euler's Model, Webber's model, Mach model, scale effects, Distorted models. Numerical problems on Reynold's, and Froude's Model.	**04**	**L1, L2, L3**
Buoyancy and Flotation Buoyancy, Force and Centre of Buoyancy, Metacentre and Metacentric height, Stability of submerged and floating bodies, Determination of Metacentric height, Experimental and theoretical method, Numerical problems	**03**	**L1, L2, L3,L4**
Module 2: Open Channel Flow Hydraulics	**10**	
Uniform Flow Introduction, Classification of flow through channels, Chezy's and Manning's equation for flow through open channel, Most economical channel sections, Uniform flow through Open channels, Numerical Problems.	**06**	**L3,L4**
Specific Energy and Specific energy curve, Critical flow and corresponding critical parameters, Metering flumes, Numerical Problems	**04**	**L2, L3**
Module 3: Non-Uniform Flow	**10**	
Hydraulic Jump, Expressions for conjugate depths and Energy loss, Numerical Problems	**03**	**L2,L3,L4**
Gradually varied flow, Equation, Back water curve and afflux, Description of water curves or profiles, Mild, steep, critical,	**04** **03**	**L2,L3**

horizontal and adverse slope profiles, Numerical problems, Control sections		
Module 4: Hydraulic Machines	**10**	
Introduction, Impulse-Momentum equation. Direct impact of a jet on a stationary and moving curved vanes, Introduction to concept of velocity triangles, impact of jet on a series of curved vanes- Problems	**05**	**L2,L3**
Turbines – Impulse Turbines		
Introduction to turbines, General lay out of a hydro-electric plant, Heads and Efficiencies, classification of turbines. Pelton wheel-components, working principle and velocity triangles. Maximum power, efficiency, working proportions – Numerical problems	**05**	**L1, L2, L3,L4**
Module 5: Reaction Turbines and Pumps	**10**	
Radial flow reaction turbines: (i) Francis turbine- Descriptions, working proportions and design, Numerical problems. (ii) Kaplan turbine- Descriptions, working proportions and design, Numerical problems. Draft tube theory and unit quantities. (No problems) Centrifugal pumps: Components and Working of centrifugal pumps, Types of centrifugal pumps, Work done by the impeller, Heads and Efficiencies, Minimum starting speed of centrifugal pump, Numerical problems, Multi-stage pumps.	**06** **04**	**L1,L2, L3,L4**

COURSE OUTCOMES:

After a successful completion of the course, the student will be able to:

1. Apply dimensional analysis to develop mathematical modeling and compute the parametric values in prototype by analyzing the corresponding model parameters
2. Design the open channels of various cross sections including economical channel sections
3. Apply Energy concepts to flow in open channel sections, Calculate Energy dissipation, Compute water surface profiles at different conditions
4. Design turbines for the given data, and to know their operation characteristics under different operating conditions

Program Objectives

1. PO1: Engineering Knowledge
2. PO2: Problem analysis
3. PO3: Analyse and development of Solutions

Question Paper Pattern:

- Total number of Questions to be set is 10. Two full questions are to be set from each module.
- Not more than 3 sub questions are to be set under any main question
- Questions are to be set such that the entire module is covered and further, should be answerable for the set marks.
- Each question should be set for 16 marks
- Students should answer 5 full questions selecting at least 1 from each module.

Text Books:

1. P N Modi and S M Seth, "Hydraulics and Fluid Mechanics, including Hydraulic Machines", 20th edition, 2015, Standard Book House, New Delhi
2. R.K. Bansal, "A Text book of Fluid Mechanics and Hydraulic Machines", Laxmi Publications, New Delhi
3. S K SOM and G Biswas, "Introduction to Fluid Mechanics and Fluid Machines", Tata McGraw Hill,New Delhi

Reference Books:

1. K Subramanya, "Fluid Mechanics and Hydraulic Machines", Tata McGraw Hill Publishing Co. Ltd.
2. Mohd. Kaleem Khan, "Fluid Mechanics and Machinery", Oxford University Press
3. C.S.P. Ojha, R. Berndtsson, and P.N. Chandramouli, *"Fluid Mechanics and Machinery"*, Oxford University Publication – 2010
4. J.B. Evett, and C. Liu, *"Fluid Mechanics and Hydraulics*", McGraw-Hill Book Company.- 2009.