Course title: Advanced Hydraulics			
Course code: WSW 133	**No. of credits** 4	**L-T-P distribution:**34-26-0	**Learning hours:** 60
Pre-requisite course code and title (if any) : Basic Hydraulics			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr. Sherly M.A.		**Course instructors(s):** Dr. Sherly M.A.	
Contact details: sherly.ma@terisas.ac.in			
Course type	Core	**Course offered in: Semester** 1	

Course description

Water specialists need to understand the behavior of fluid flow in different conditions in pipes, channels, canals, notches, weirs etc. The basic knowledge about hydraulics and fluid mechanics will be useful in subjects like Irrigation, Water Resources Management and Public Health Engineering. In this course, basics of hydraulics and its application oriented content has been kept with a focus that students should be able to solve practical problems. Competencies developed by this course would therefore be useful for students while performing his/her job in the field of Water resources / Irrigation/PHE and Environmental Engineering.

Course objectives

- To understand advanced hydraulic concepts and apply in practical engineering problems of water conveyance in pipes, pipe networks, and open channels.
- Describe the operating characteristics of hydraulic machinery (pumps and turbines), and the factors affecting their operation and specifications, as well as their operation in a system.

Course content

Module	Topic	L	T	P
1.	**Review of Fluid Mechanics** Properties of Fluids and classification of fluids **Fluid Statics and Kinematics** Pressure measurement by Manometers, Classification of flow, Laminar and Turbulent Flows, Equation for Acceleration, Continuity Equation, including Circulation and Vorticity, Irrotational and rotational flow, Velocity potential **Dynamics of Fluid Flow** Laws affecting fluid motion, Euler's Equation, Bernoulli's Equation, Pressure variation across a uniform conduit, Pressure variation across a uniform bend, Energy Equation, Pitot Tube, Venturimeter, Flow through reservoir opening, Cavitation, Momentum principle and equation	6	7	0
2.	**Uniform Flow** Characteristics of flow through pipes, head losses, Darcy Weisbach Equation, Hydraulic Gradient Line (HGL) and Total Energy Line (TEL), Flow through pipes in series parallel and equivalent pipes. Hardy Cross method-method of balancing heads, single and multiple source pipe networks with known resistances. Newton Raphson method-basic concepts Characteristics of open channel flow , Comparison of pipe flow and channel flow, Froud's number, Hydraulic mean depth- concept & computation, Use of Chezy's and Manning's formulae.	10	6	0
3.	**Varied Flow** Gradually varied flow-dynamic equation, characteristics and classification of flow profiles Rapidly varied flow: momentum principle, Hydraulic Jump, hydraulic jump in a rectangular channel, loss of energy in a hydraulic jump	6	6	0
4.	**Dimensional Analysis** Dimensional analysis and model simulation-Buckhingham-pi theorem and its application, model studies	4	2	0
5.	**Water Power Engineering** Electrical Load on Hydro Turbines, Types of hydro-power plants,Turbines-Working Principles of Pelton, Francis and Kaplan turbines, Cavitation, Examples of Hydro-Power Projects	8	5	0
	Total	**34**	**26**	**0**

Evaluation criteria

Minor 1: 25%
Minor 2: 25%
End-term exam: 50%

Learning outcomes

- Apply the concepts of fluid statics and dynamics.
- Be able to analyse problems of flow in pipes and open channels
- Be able design pipe flow networks, including location of pumps and valves.
- Solve problems based on flow through weirs, notches and orifices
- Analyse flood routing problems in urban areas

Pedagogical approach

Classroom teaching will involve black board, power point presentations, and case study analysis. The sessions will be interactive and students will be expected to make presentations on specific research topics.Extensive numerical/tutorial classes will be held which shall be compulsory

Materials

1. Cengel, Y.A., and J.M. Cimbala, (2010) Fluid Mechanics: Fundamental and Applications, Tata McGraw Hill.
2. Fluid Mechanics Modi& Seth Standard Book House, New Delhi
3. Fluid Mechanics A.K.Jain,Khanna Publishers, New Delhi
4. Fluid Mechanics & Machinery H. M. Raghunath CBS Publishers, New Delhi
5. Computer Modeling of Water Distribution Systems. AWWA MANUAL M32Third Edition. Publisher: American Water Works Association
6. Analysis of Water Distribution Networks by Pramod Bhave, R Gupta. Publisher: Narosa Publishing House
7. Flow in open channels, Subramanya, K.,– Tata McGraw Hill
8. Open Channel Hydraulics, Chow,V.T.- McGraw Hill .
9. Applied Hydrology, Chow, V.T.,Maidment, D.R. and Mays L.W, McGraw Hill

Additional information (if any)

Student responsibilities

Attendance and class participation will be given utmost importance. All assignments should be submitted as per the given timeline.

Course reviewers

1. Prof NarenderKanhe, Principal, Guru Nanak Institute of Engineering and Management, Nagpur.
2. MrSundeep Singh, Sr Environmental Engineer (Scientist-D), CPCB, India.