Course title: Hydraulics			
Course code: WSW 131	**No. of credits** 3	**L-T-P distribution:**30-18-0	**Learning hours:** 42
Pre-requisite course code and title (if any) : None			
Department: Department of Regional Water Studies			
Course coordinator(s): Dr. Rinki Deo		**Course instructors(s):** Dr. Rinki Deo	
Contact details:			
Course type	**Core**	**Course offered in: Semester 1**	

Course description

Water specialists need to understand the behaviour 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

- Apply fundamental principles of fluid mechanics for the solution of 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.	**Properties of Fluids** Introduction, Density, Specific Weight, Viscosity, Newtonian and Non Newtonian Fluids, Kinematic Viscosity, Surface Tension, Capillary and their units, dimensions and significance. Classification of fluids as ideal and real fluids, Newtonian and non-Newtonian fluids, incompressible and compressible fluids,solve numericals.	4	2	
2.	**Fluid Statics and Kinematics** Introduction, Variation of Static Pressure, Absolute and Gauge pressure, Pressure measurement by Manometers, Forces on plane surfaces, Forces on curved surfaces, Buoyant Forces, Classification of flow, Laminar and Turbulent Flows, Acceleration of flow in one direction, Continuity Equation,solve numericals	4	2	
3.	**Dynamics of Fluid Flow** Introduction, Transport Phenomenon, Laws affecting fluid motion, Euler's Equation, Bernoulli's Equation, limitation and modification of Bernoulli's equation, application of Bernoulli's equation-venturimeter,orifice meter and pitot tube,solve numerical	4	2	
4.	**Flow through Pipes** Characteristics of flow through pipes, Major and Minor Energy (Head) losses in pipe flow- frictional loss, loss of head at entry, exit, sudden enlargement and contraction and at bend, Darcy Weisbach Equation, Hydraulic Gradient Line (HGL) and Total Energy Line (TEL), Flow through pipes in series, parallel and equivalent pipes, solve numerical.	4	4	
5.	**Flow through open channel** Characteristics of open channel flow , Comparison of pipe flow and channel flow, Hydraulically efficient channel cross section, Analyse uniform flow , Froud's number and its significance, Hydraulic mean depth- concept & computation, Use of Chezy's and Manning's formulae, Most economical sections of channel Rectangular, Trapezoidal and circular shapes, solve numericals.	6	4	
6.	**Flow Measurement** Definition and types of orifice, Various Hydraulic Coefficient and its relation - Coefficient of Contraction, Velocity, Discharge, Types of notches and weirs, Computation of discharge through notches-Rectangular Notch, V - Notch. Computation of Discharge through narrow crested and broad Crested weir, Discharge through Cipolletti weir,solve numericals	4	2	

7.	**Pumps and Turbines** Classification, description and general principles of operation of pumps, work done and efficiencies of centrifugal pumps Hydraulic Turbines: Working Principles of Pelton, Francis and Kaplan turbines	4	2	
	Total	**30**	**18**	

Evaluation criteria

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

Learning outcomes

- Solve the problems related to properties of fluids.
- Apply the concepts of fluid statics and dynamics.
- Apply the concepts of flow measurement
- Solve the problems related to flow through pipes and channels.
- Solve the problems based on flow through weirs, notches and orifices

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 examples shall be solved during the tutorial classes.

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.JainKhanna Publishers, New Delhi
4. Fluid Mechanics & Machinery H. M. Raghunath CBS Publishers, New Delhi
5. Fluid Mechanics and Fluid Machines S. K. Som& G. Biswas, Tata McGraw Hill
6. Fluid Mechanics, Hydraulics and Fluid Machines S. Ramamrutham, DhanpatRai

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. Mr Sundeep Singh, Sr Environmental Engineer (Scientist-D), CPCB, India.