Semester	**:**	**III**		
Course No.	**:**	**IDE-231**	**Credit Hrs.**	**: 3(2+1)**
Course Title	**:**	**Fluid Mechanics and Open Channel Hydraulics**		

SYLLABUS

Objectives : To make the students acquainted with the behaviour of fluids at rest and in motion and to enable them to apply the principles to design simple fluid mechanical systems in engineering

THEORY

Properties of fluids: Ideal and real fluid units; Pressure and its measurement, Pascal's law, pressure forces on plane and curved surfaces, center of pressure, pressure diagram, application of hydrostatics in engineering structures; Buoyancy, Archimedes' principle, metacenter and meta- centric height, condition of floatation and stability of submerged and floating bodies.

Kinematics of fluid flow: Lagrangian and Eulerian description of fluid motion, continuity equation, path lines, streak lines and stream lines, stream function, velocity potential and flow net. Types of fluid flow, translation, rotation, circulation and vorticity, Vortex motion; Dynamics of fluid flow, Bernoulli's theorem, venturimeter, orifice meter and pitot tube, siphon.

Flow through orifices (Measurement of Discharge, Measurement of Time), Flow through Mouthpieces, Flow over Notches, Flow over weirs, end contraction of rectangular weir, ventilation of weirs, various types of nappes.

Laminar and turbulent flow in pipes, General equation for head loss Darcy equation, Moody's diagram, minor and major hydraulic losses through pipes and fittings, Flow through network of pipes, Hydraulic gradient and energy gradient, Chezy's formula for loss of head in pipes, Flow through simple and compound pipes, Transmission of power through pipes.

Open channel design and hydraulics: Chezy's formula, Bazin's formula, Kutter's Manning's formula, Best hydraulic section, Velocity and Pressure profiles in open channels, Hydraulic jump, Discharge measurement in open channel: Current meter;

Dimensional analysis and similitude: Rayleigh's method and Buckingham's `Pi' theorem, Types of similarities, Dimensionless numbers. Introduction to fluid machinery.

PRACTICAL

Study of manometers and pressure gauges; Study of transmissibility of liquid pressure; Study of various types of flow such as laminar flow, uniform flow, steady flow, vertex flow rotational flow; Determination of meta centric height; Verification of Bernoulli's theorem; Determination of coefficient of discharge of venturimeter and orifice meter; Determination of coefficient of friction in pipeline; Determination of coefficient of discharge for rectangular notch and triangular notch.; Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice; Determination of coefficient of discharge for mouth piece.; Determination of efficiency of hydraulic ram; Measurement of velocity by current meter.; Study of open channel flow.; Velocity distribution in open channels and determination of Manning's coefficient of Rugosity and Chezy's roughness coefficient; Study of various types of models and prototypes: geometrical, kinematic and dynamic similarities; Study on non-dimensional constants such as Froud's number and Reynold's number; Study of various types of pumps and its components.

TEACHING SCHEDULE

THEORY [IDE-231]

Lecture No.	Topic	Sub- topics/ Key Points	Weightage, (%)
1	Properties of Fluids	Introduction, Properties of fluid, Types of fluids: Ideal and Real fluid.	15
2 -7	Pressure and its Measurement	Fluid pressure at point, Pascal's law, Absolute, Gauge, Atmospheric and Vacuum pressure. Piezometer, U-tube manometer, Single column manometer, U-tube differential manometers, Inverted U-tube differential manometer, Mechanical gauges.	
8 - 10	Pressure Forces on Plane and Curved Surfaces	Total pressure and center of pressure, Pressure diagram, Vertical plane surface submerged in liquid, Horizontal plane surface submerged in liquid, Inclined plane surface submerged in liquid, Curved surface sub-merged in liquid. Application of hydrostatics in engineering structures.	15
11 - 13	Buoyancy and Floatation	Archimedes's Principle, Introduction, Buoyancy, Center of buoyancy, Meta-centre, Metacentric height, Analytical method for metacentric height.	
		Conditions of floatation and stability of submerged and Floating bodies.	

Continued…

14 - 15	Kinematics of Fluid Flow	Lagrangian and Eulerian description of fluid motion.	10
16	Description of the Flow Pattern	Path lines, streak lines and stream lines, stream tube, Types of fluid flow, Translation, Rotation, Circulation and Vorticity, Vortex motion. Velocity potential function and Stream function, Vorticity, Flow net.	
17 - 18	Dynamics of Fluid Flow	Venturimeter, Bernoulli's equations; Orifice meter, Nozzle (Pitot-tube), Siphon.	
19 - 21	Flow through Orifices and Mouth Pieces; Flow through Notches, Weirs	Introduction, Classifications of orifices, Classifications of mouthpieces, Measurement of discharge, measurement of time. Classification of notches and weirs, Discharge over a rectangular notch or weir, Ventilation of weirs, Various types of nappe.	10
22 - 24	Laminar and Turbulent Flow in Pipes	General equation for head loss, Darcy equation, Moody's diagram; Major and minor hydraulic losses through pipes and fittings. Chezy's formula for loss of head in pipes. Flow through simple and compound pipe. Flow through network of pipes, Power transmission through pipes. Hydraulic gradient and energy gradient.	10
25 - 28	Open Channel Design and Hydraulics	Chezy's formula and Manning's formula, Bazin's formula, Ganguillet-Kutter's formula, Best hydraulic section, velocity and pressure profiles in open channels, Hydraulic jump, Discharge measurement in open channels; Current meter.	30
29 - 31	Dimensional Analysis and Similitude	Rayleigh's method, Buckingham's π – theorem, Types of similarities (Similitude), Dimensionless numbers.	10
32	Introduction of Fluid Machinery	Fluid machinery; Hydraulic ram.	
		Total =	**100**

TEACHING SCHEDULE

PRACTICAL [IDE-231]

Exercise No.	Exercise Title
1	Study of manometers and pressure gauges.
2	Study of transmissibility of liquid pressure.
3	Study of various types of flow such as laminar flow, uniform flow, steady flow, vertex flow, rotational flow.
4	Determination of meta centric height.
5	Verification of Bernoulli's theorem.
6	Determination of coefficient of discharge of venturimeter.
7	Determination of coefficient of discharge of orifice meter.
8	Determination of coefficient of friction in pipeline.
9	Determination of coefficient of discharge for rectangular notch and triangular notch.
10	Determination of coefficient of discharge, coefficient of velocity and coefficient of contraction for flow through orifice.
11	Determination of coefficient of discharge for mouth piece.
12	Determination of efficiency of hydraulic ram.
13	Study of open channel flow and measurement of velocity by current meter.
14	Velocity distribution in open channels and determination of Manning's coefficient of Rugosity and Chezy's roughness coefficient.
15	Study of various types of models and prototypes: geometrical, kinematic and dynamic similarities.
16	Study on non-dimensional constants such as Froude's number and Reynold's number and Study of various types of pumps and its components.

Suggested Readings [IDE-231]:

1. Bansal R.K. A Text Book of Fluid Mechanics and Hydraulic Mechanics (10th edition). Laxmi Publications (P) Ltd., New Delhi.
2. Modi P.N and Seth S.M. 2017. Hydraulics and Fluid Mechanics (including Hydraulic Machines) (16th Edition). Standard Book House, Delhi-6.
3. Garg S.K. Irrigation Engineering and Hydraulic Structures. Khanna Publisher, New Delhi.
4. Jagdish Lal. Fluid Mechanics. Metropolitan Books CI. Pvt. Ltd. New Delhi.
5. Ramanuthan S. 2011. Hydraulics, Fluid Mechanics and Hydraulic Machines. Dhanpat Rai and Sons, New Delhi.
6. Khurmi R.S. and Khurmi N.S. 1987. Hydraulics, Fluid Mechanics and Hydraulic Machines. S. Chand & Co. Ltd., New Delhi.