



## Birla Institute of Technology & Science, Pilani

Hyderabad Campus

### FIRST SEMESTER 2022-2023 Course Handout Part II

Date: 29-08-2022

In addition to Part I (General Handout for all courses appended to the Time Table), this portion gives further specific details regarding the course.

Course No. : **CE F312**  
Course Title : **Hydraulic Engineering**  
Instructor-in-charge : **JAGADEESH ANMALA**  
Instructors : Voleti Rishith Kumar, Nagalapalli Satish, Deepjyoti Deb

#### Scope and Objective of the Course:

The problems encountered by man in the field of water supply, irrigation, environment, navigation and water- power, resulted in the development of the fluid mechanics. Fluid mechanics deals with the behavior of the fluids at rest as well as in the motion. This course will stress the governing principles of Hydraulic Engineering; the assumptions made in their development and their limits of applicability, and will show how the principles can be applied to the solution of practical engineering problems such as water supply systems, waste water treatment facilities, dam spillways, flow-meters, hydraulic shock absorbers etc. The fluid flows under different conditions have also been included so that the students learn to apply in practical life and relate with the environment.

**Course Outcomes:** By the end of the course, the student will be able to

- CO1. Formulate necessary steps required to design and conduct hydraulic engineering experiments; interpret and analyze the data
- CO2. Analyze and solve problems in the applications of boundary layer theory and turbulent flows
- CO3. Analyze and solve problems related to pipe network analysis (and do a project using WaterGEMs) and open channel flows that are very important from a practitioner's aspect
- CO4. Analyze, design and solve problems in the areas of lift and drag, impact of jets, turbomachinery.

**SLOs covered: (a), (b), (e), (k)**

#### Text Book:

- T1. Modi, P.N. and Seth, S.M., Hydraulics and Fluid Mechanics, Standard Book House, 22<sup>nd</sup> ed., 2019.

#### Reference Books:

- R1. Fox, R.W. and McDonald, A.T., Introduction to Fluid Mechanics, John Wiley and Sons Inc., Tenth Edition, 2020.
- R2. Laboratory Manual of CE F312 Hydraulic Engineering
- R3. <https://nptel.ac.in/courses/112/104/112104118/>
- R4. <https://nptel.ac.in/courses/112/105/112105218/>
- R5. <https://nptel.ac.in/courses/112/105/112105269/>
- R6. <https://nptel.ac.in/courses/105/103/105103192/#>

**Course Plan :**

<b>Lecture No.</b>	<b>Learning Objective</b>	<b>Topics to be covered</b>	<b>Chapter in the Text Book</b>	<b>SLO*</b>
1-2	To explain fluid and laws of fluid mechanics in physical terms. To revise the concepts of system, control volume etc.	Introduction, Fundamental definitions and concepts	T1 Chapter 1 T2 Chapter 1	(a)
3-7	To describe BL and its equations, momentum integral equation, laminar and turbulent BLs etc.	Boundary layer (BL) theory	T1 Chapter 12 R1 Chapter 11	(a), (e)
8-12	To study Prandtl's mixing length hypothesis, Turbulent flow in smooth and rough pipes, Resistance to fluid flow etc.	Turbulent flow in pipes	T1 Chapter 14 R1 Chapter 10	(a), (e)
13-17	To solve pipe networks using Hardy Cross Method and Linear Graph Method; Design using WaterGEMs; Water hammer; Pipes, valves, fittings, pumps;	Flow through pipes and pipe systems	T1 Chapter 11	(a), (e), (k)
18-21	To study uniform flow etc., Manning's and Chezy's equations, Best hydraulic section, Specific energy and force, critical depth etc.	Flow in open channels	T1 Chapter 15	(a), (e)
22-25	To study Gradually varied flow, Rapidly varied flow, Channel bottom slopes and surface profiles, Integration of varied flow, Hydraulic Jump etc.	Non-uniform flow in channels	T1 Chapter 16	(a), (e)

26-29	To study drag and lift of fluid flow around submerged objects	Lift & Drag	T1 Chapter 18 R1 Chapter 12	(a), (e)
30-34	To Analyze Impact of jets including jet impingement in moving Vanes and series of vanes, curved vanes, efficiencies, torque etc.	Impact of Jets	T1 Chapter 20	(a), (e)
35-38	To study Turbo-machinery analysis, performance characteristics, applications to fluid systems	Fluid machineries	T1 Chapter 21,22 R2 Chapter 10	(a), (e)
39-42	To study the principles of reciprocating pumps and centrifugal pumps	Pumps	T1 Chapter 23, 24	(a), (e)
43	Differential equations, finite-difference method and grid generation, boundary conditions and initial conditions, applications of computational hydraulics	Overview of computational hydraulics	Supplementary notes by IC	(a), (e), (k)

**\*Student Learning Outcomes (SLOs):**

SLOs are outcomes (a) through (k) plus any additional outcomes that may be articulated by the program.

- (a) an ability to apply knowledge of mathematics, science and engineering
- (b) an ability to design and conduct experiments, as well as to analyze and interpret data
- (c) an ability to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability
- (d) an ability to function on multidisciplinary teams
- (e) an ability to identify, formulate, and solve engineering problems
- (f) an understanding of professional and ethical responsibility
- (g) an ability to communicate effectively
- (h) the broad education necessary to understand the impact of engineering solutions in a global, economic, environmental, and societal context
- (i) a recognition of the need for, and an ability to engage in life-long learning
- (j) a knowledge of contemporary issues
- (k) an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice.

**Practical :**

S. No.	Name of Experiment	No. of Turns	Reference to Lab Manual
1.	Darcy's Friction factor ' $f$ ' of pipes of different diameter pipes (Darcy)	01	R6
2.	Discharge through an orifice and a mouthpiece (OP/MP)	01	R6
3.	Verification of Bernoulli's Theorem (Bernoulli)	01	R6
4.	The coefficient of discharge ' $C_d$ ' of the V notch and rectangular notch and to plot the calibration curve (Notches)	01	R6
5.	Working and Efficiency of Francis Turbine (Francis)	01	R6
6.	Study of Impact of Jet (IJ)	01	R6
7.	Study of Metacentric Height Apparatus (MH)	01	R6
8.	Flow measurement using Venturimeter/Orificemeter (VM/OM)	01	R6
9.	Study of Reynolds Apparatus (Reynolds)	01	R6
10.	Boundary layer development on a flat plate (BLF)	01	R6
11.	Drag and Lift of Aerofoil (Aerofoil)	01	R6
12.	Study of formation of Hydraulic Jump (HJ- open channel)	01	R6
13.	Broad Crested Weir (BCW- open channel)	01	R6

**In addition to the above mentioned SLOs, SLO (b) will be covered through laboratory experiments.**

**Reading Assignment:** First 8 Chapters of textbook.

**Evaluation Scheme:**

Evaluation Component	Duration (Minutes)	Weightage (%)	Date & Time	Nature of Component
Mid-sem Examination	90	25	02/11 3.30 - 5.00PM	Closed book
WaterGEMs project		10	To be announced in the class from time to time	Open book
Laboratory Records		15	As per timetable	Open book
Quiz (including Lab)		15	To be announced in the class	Open book
Comprehensive Examination	180	35	23/12 AN	Closed book

**Chamber Consultation Hour:** Friday (4 PM to 5 PM).

**Make-up Policy:**

Make-ups are not usually encouraged. Make-up will be granted only on genuine reasons. However, prior permission is must. For medical cases, a certificate from the concerned physician of the Medical Centre must be produced.

**Notices:** All notices concerning the course will be displayed on Google class room.

**Academic Honesty and Integrity Policy:** Academic honesty and integrity are to be maintained by all the students throughout the semester and no type of academic dishonesty is acceptable.

**Instructor-in-charge**