Marwadi University
Marwadi Chandarana Group

Bachelor of Technology

Civil Engineering

Applied Fluid Mechanics in Civil Engineering

01CI1513

Objective of the Course:

- To understand & solve problems of fluid flow through pipes.
- To analyze the flow in open channels.
- To design optimum cross section for various types of channels.
- To learn the characteristics of turbo-machines.
- To introduce dimensional analysis and model similitude.

Credit Earned: 03

Prerequisite: Fluid Mechanics

Student's learning outcomes:

After successful completion of the course, it is expected that students will be able to,

1. Analyze fluid flow through pipes in series, parallel and pipe networks under laminar and turbulent flow conditions
2. Design optimal channel sections for the uniform flow condition.
3. Determine the water surface profile for the non-uniform flow condition.
4. Understand the performance characteristics of hydraulic machines.
5. Introduction to model similitude.

Teaching and Examination Scheme

Teaching Scheme (Hours)			Credits	Theory Marks			Tutorial/ Practical Marks		Total Marks
Theory	Tutorial	Practical		ESE (E)	IA (M)	CSE (I)	Viva (V)	Term Work (TW)	
02	00	02	03	50	30	20	25	25	150

Detailed Syllabus

Sr No.	Title of the unit	Number of hours
1	**Flow Through Pipes**	**08**
	1.1 Non-Viscous flow Introduction, Continuity Equation, Energy Equation, Momentum Equation, Major and minor energy losses, hydraulic gradient and total energy line, pipes in series & parallel, pipe networks, hydraulic transmission of power.	4

	1.2 Viscous Flow Navier-Stokes equation of motion- Initial conditions and boundary conditions. Viscous flow through circular pipe, Viscous flow-Couette flow, Hagen- Poiseuille equation-flow between parallel plates. Turbulent flow in pipes- Prandtl's mixing length theory- velocity distribution- Smooth and rough boundaries-water hammer phenomenon	4
2	**Open Channel Flow**	**07**
	2.1 Uniform flow Basic concept of open channel flow- Steady uniform flow-Velocity distribution-Optimum shape of cross section for uniform flow- Energy equation-specific energy-specific energy diagram- discharge diagram-Application of specific energy and discharge diagrams.	3
	2.2 Non-Uniform flow Non-Uniform steady flow-equations for gradually varied flow- Direct Step method, rapidly varied flow- Hydraulic jump- Location of hydraulic jump- flow under sluices-Water surface profiles.	4
3	**Turbo Machinery**	**07**
	3.1 Water Turbines Impulse turbine-Reaction turbine, Specific Speed-Unit quantities, Performance characteristics for water turbines,	4
	3.2 Centrifugal pumps Pumps in series and parallel, Specific speed, Unit quantities, and characteristics curves, Cavitation in turbines and pumps.	3
4	**Dimensional Analysis and Similitude**	**06**
	4.1 Dimensional analysis Fundamental dimensions- Physical Quantity and Dimensions-Dimensional Homogeneity- Non-Dimensional parameters, Theorem dimensional analysis, Choice of variables, Determination of Dimensionless parameters.	3
	4.2 Model Similitude Model Similitude-Physical models- geometric-kinematic and dynamic similarity, Model studies.	3
	Total	**28**

Major Equipment:

Pipe friction apparatus, Test ring for hydraulic jump, Test ring for centrifugal pump, Test ring for Pelton turbine, Test ring for Francis turbine, Test ring for Kaplan turbine

List of Experiments

1) To study pipe friction
2) To study Uniform flow and Hydraulic Jump
3) To Study of hydraulic force
4) To Study the Operation of a Pelton Turbine
5) To study the operation of a Francis Turbine
6) To Study the operation of a Kaplan Turbine
7) To Study of centrifugal pump characteristics
8) To Study of Reciprocating pumps characteristics
9) To study the operation of a double stage air compressor
10) To study the types of Flow and Head loss
11) To study the open channel flow
12) To study water surface profile
13) To study design of hydraulic machineries
14) To study the dimensional analysis

Suggested Theory Distribution

The suggested theory distribution as per Bloom's taxonomy is as per follows. This distribution serves as guidelines for teachers and students to achieve an effective teaching-learning process

Distribution of Theory for course delivery and evaluation					
Remember	Understand	Apply	Analyze	Evaluate	Create
10%	20%	40%	15%	10%	5%

Instructional Method and Pedagogy:

1. At the start of course, the course delivery pattern, prerequisite of the subject will be discussed.
2. Lectures will be taken in class room with the use of multi-media presentations, white board– mix of both.
3. Attendance is compulsory in lectures and laboratory which carries a 5% component of the overall evaluation.
4. Minimum two internal exams will be conducted and average of two will be considered as a part of 15% overall evaluation
5. Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval. It carries a weightage of 5%.
6. Surprise tests/Quizzes will be conducted which carries 5% component of the overall evaluation.

7. The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures. Minimum 8 experiments are planned based on the course content.

Recommended Study Material

1. Fluid Mechanics and Hydraulic Machines by R. K. Rajput, S. Chand Publication
2. Fluid Mechanics by A.K. Jain, Khanna Publishers, New Delhi
3. Fluid Mechanics & Hydraulic Machines, R.K. Bansal, Laxmi Publication.
4. Theory and Applications of Fluid Mechanics by K Subramanya, McGraw Hill Publication
5. Hydraulics and Fluid Mechanics by P.N. Modi and S.M. Seth, Standard Book House, New Delhi
6. Fluid Mechanics by Victor L. Streeter, E. B. Wylie by, McGraw Hill Publication
7. Fluid Mechanics by Frank M White, McGraw Hill Publication