Hydraulics Engineering

Course Code	Credit Hours
CE-464	2-1

Course Description

This course extends the theory of uniform flow to encompass the frequently occurring non-uniform flows commonly encountered in real-world applications. The chapter on unsteady flow treats the cases of sudden valve closure. The curriculum covers advanced topics such Hydraulic structures, Dams and Hydropower engineering, Similitude and Dimensional analysis.

Text Book:

1. J. F. Douglas, J. A. Swaffield “Fluid Mechanics” fourth edition.
2. Hubert Chanson, “The hydraulics of Open Channel Flow: An Introduction” second edition.
3. Graf and Altinakar, “Fluivial Hydraulics”.

Reference Book:

1. Open Channel Hydraulics. Terry W. Sturm. Latest Edition.
2. Open Channel Flow. Francis M. Henderson, Latest edition

Prerequisites :

1. CE-211 Fluid Mechanics
2. CE-215 Advanced Fluid Mechanics

Assessment System for Theory

	Without Project (%)	With Project/Complex Engineering Problems (%)
Quizzes	15	10-15
Assignments	10	5-10
Mid Terms	25	25
Project	-	5-10
End Semester Exam	50	45-50

Assessment System for Lab

Lab Work/ Psychomotor Assessment/ Lab Reports	70%
Lab Project/ Open Ended Lab Report/ Assignment/ Quiz	10%
Final Assessment/ Viva	20%

Teaching Plan

Theory:

Week	Topics	Reading Assignment	CLO No.	Assessment
1	Subcritical, supercritical flow and critical depth. Flow in venture flume and over broad-crested weir	Chapter 16 Douglas,	1	
2	Hydraulic Jump and occurrence & utility. Derivation of equation & problems. Humps and constriction	Chapter 16 Douglas,	1	Quiz # 1
3	Dynamic equation of gradually varied flow. Water surface profiles	Chapter 16, Douglas,	1	Quiz # 2 Assig # 1
4-5	Quasi steady flow through pipe, orifice under varying head	Chapter 14 Douglas,	1	PBL/Assig # 2
6	Surges in open channels. Water hammer; slow and rapid valve closure.	Chapter 20 Douglas,	1	Quiz # 3 Complex Engg Problem
7	Mid semester Exam			
8	Similitude in Hydraulic models. Similitude requirements, geometric, kinematics and dynamics similarities,	Chapters 8 & 9 Douglas,	1	Assig # 3
9-10	**Dimensional Analysis and Similitude** Dimensionless numbers and their significance. Releigh's method. Buckingham's PI-theorem and its application. Physical models, techniques and analysis. Introduction to numerical models	Chapters 8 & 9 Douglas,	1	
11	**Hydraulic Structures** Canal Falls, flumes, canal outlets. Cross drainage works: types and functions	Hand out	1	Quiz # 4
12-13	**Dams and Hydro Power Engineering** Selection of hydropower sites. Components and layout of hydropower schemes. Types of storage dams, forces on dams,	Hand out	1	Quiz # 5

	design of gravity dams. Reservoir engineering, operation and regulation of storage reservoirs. Sediment Transport in Channels. Sedimentation Problems in Reservoirs.			
14	**Drainage** Definition, Land reclamation Surface Drainage. Subsurface Drainage. Estimation of discharge capacity of Cross-drainage Structures. Disposal of drainage effluents	Hand out	1	PBL/Assig #4
15	**Advanced Topics in Hydraulics** Modern trends in hydraulic engineering. Computational fluid dynamics (CFD). Case studies and real-world applications.		1	
16	A brief introduction to Artificial Neural Network (ANN). Experiments of sediment transport performed in steep slope channels. Application of ANN to reproduce the observed dimensionless sediment volume. Assessing the model results through performance indices.	Hand out		Quiz # 6

Practicals:

No.	Practical
1	To measure water level and velocity along the channel.
2	To estimate flow rate through changes in the channel section.
3	To analyze water hammer phenomena through water hammer apparatus.
4	Characterization of the hydraulic jump.
5	To study the subcritical and supercritical flows.
6	Application and understanding of Manning formula.
7	To demonstrate flow over weir in open channel.
8	Perform experiment on flume to plot E~y diagram for uniform flow.
9	To examine the flow through sluice gate in open flow channel.
10	To produce a hydraulic jump in tilting flume.
11	Relationship between backwater level and discharge level.
12	To examine the sediments transport and settling mechanisms.
13	Simulation of water structure interaction using hydraulic modeling