

**COURSE CODE:** CE-455  
**COURSE NAME:** Water Resources and Irrigation Engineering  
**CREDIT HOURS:** Theory = 2 Practical = 1 Total = 3  
**CONTACT HOURS:** Theory = 32 Practical = 16 Total = 40  
**PREREQUISITE:** None  
**MODE OF TEACHING:** Two hours of lecture per week  
Three hours of Lab work per week

### **COURSE DESCRIPTION:**

This course is designed to familiarize the students of environmental engineering with the knowledge of water resources management and irrigation engineering. The course is divided into five sections. The first section discusses the water resources with a special focus on Pakistan's water resources and Indus Water Treaty. Second sections of the course will be covering topics such as water requirement, irrigated agriculture, and types of irrigation methods (traditional and advanced) with an added focus on canal irrigation systems and losses. Third and Fourth section discusses canal irrigation system, design of irrigation channels (Canals) and description of control structures such as dams, barrages, and headworks with a focus on their various components including canal head regulators, falls, canal outlets, cross drainage works, canal lining and maintenance of irrigation canals. Fifth section discusses the problems associated with irrigation i.e. Water logging and salinity together with the concept of drainage.

### **RELEVANT PROGRAM LEARNING OUTCOMES (PLOs):**

The course is designed so that students will achieve the PLOs:

- |                                    |                                     |                                   |                                     |
|------------------------------------|-------------------------------------|-----------------------------------|-------------------------------------|
| 1 Engineering Knowledge:           | <input checked="" type="checkbox"/> | 7 Environment and Sustainability: | <input type="checkbox"/>            |
| 2 Problem Analysis:                | <input type="checkbox"/>            | 8 Ethics:                         | <input type="checkbox"/>            |
| 3 Design/Development of Solutions: | <input checked="" type="checkbox"/> | 9 Individual and Teamwork:        | <input checked="" type="checkbox"/> |
| 4 Investigation:                   | <input type="checkbox"/>            | 10 Communication:                 | <input type="checkbox"/>            |
| 5 Modern Tool Usage:               | <input type="checkbox"/>            | 11 Project Management:            | <input type="checkbox"/>            |
| 6 The Engineer and Society:        | <input type="checkbox"/>            | 12 Lifelong Learning:             | <input type="checkbox"/>            |

### **COURSE LEARNING OUTCOMES:**

Upon successful completion of the course, the student will demonstrate competency by being able to:

| Sr. No. | CLO   | Domain      | Taxonomy Level | PLO |
|---------|---|-------------|----------------|-----|
| 1       | <b>UNDERSTAND</b> the basic principles of water resources planning and management, and irrigation engineering                                     | Cognitive   | 2              | 1   |
| 2       | <b>Apply</b> design considerations for open channel hydraulics and surface drainage   | Cognitive   | 3              | 3   |
| 3       | <b>Practice</b> flow measurements using various hydraulic structures  | Psychomotor | 3              | 1   |
| 4       | <b>Maintain</b> ethical conduct in lab and adhere to lab safety procedures while contributing effectively towards individual and/ or group goals. | Affective   | 5              | 9   |

### **PRACTICAL APPLICATIONS:**

Pakistan has the largest contiguous irrigation system in the world i.e. Indus Basin Irrigation System (IBIS) sustaining vast areas of croplands throughout the country. However, as water requirements are increasing, careful monitoring and designing of canal irrigation system is required to enhance its efficiency during regulation, operation and control. This course will provide our students with a chance to practically employ learned skills in an array of ways. This course will enable the environmental engineering students to understand the basic principles of water resources management and irrigation and apply those learnings on the ground.

### **TOPICS COVERED:**

| Week | Topic Covered   | Reading Assignment/<br>Homework     | CLO # |
|------|---|-------------------------------------|-------|
| 1    | Introduction to water resources & irrigation                  | Chapter 1                           | 1     |
| 2-3  | Water resources of Pakistan, Indus Water Treaty, Water Accord | Chapter 1<br>Quiz 1<br>Assignment 1 | 1     |
| 4-5  | Components of Irrigation                                      | Chapter 2<br>Assignment 2           | 1     |

|       |  |                                     |     |
|-------|--|-------------------------------------|-----|
|       |  | Quiz 2                              |     |
| 6-7   | Crop Water Requirement, Irrigation Techniques                        | Chapter 3<br>Assignment 3<br>Quiz 3 | 1   |
| 8     | Control Structures (Dams, Barrages and Headworks)                    | Chapter 4<br>Quiz 4                 | 2   |
| 9     | <b>Mid Semester Exam</b>   |                                     |     |
| 1-11  | Canal Irrigation and design of channels                              | Chapter 5<br>Assignment 4           | 2   |
| 12-13 | Canal Control and Regulation Works                                   | Chapter 6<br>Quiz 5                 | 2   |
| 14-16 | Cross Drainage Works, outlets  | Chapter 7<br>Assignment 5<br>Quiz 6 | 1,2 |
| 17    | Water logging and salinity, Drainage, Disposal of drainage effluents | Chapter 8                           | 1,2 |
| 18    | <b>End Semester Exam</b>   |                                     |     |

#### LIST OF PRACTICALS:

Not Applicable

| Sr. No. | Practical  | CLO # |
|---------|--|-------|
| 1       | Characteristics of Flow over Sharp Cornered Broad Crested Weir                                     | 3     |
| 2       | Characteristics of Flow over Round Cornered (Streamlined) Broad Crested Weir                       | 3     |
| 3       | Characteristics of Flow over Crump Weir  | 3     |
| 4       | Sluice Gate: Under Free Flow Condition Assess Q(H) & compare with $Q_{in}$                         | 3     |
| 5       | Sluice Gate: Under Submerged Condition Assess Q (H Upstream, H Downstream) & Compare with $Q_{in}$ | 3     |
| 7-8     | Flow Measurements in Parshall Flume Q(H) & Comparison with $Q_{in}$                                | 3     |
| 9       | Flow Measurements in Venturi Flume Q(H) & Comparison with $Q_{in}$                                 | 3     |
| 10      | Flow Measurements in WSC Flume Q(H) & Comparison with $Q_{in}$                                     | 3     |
| 11      | Characteristics of Flow over Gravel Bed  | 3     |
| 13-     | Characteristics of Flow over Corrugated Bed  | 3     |

|           |  |          |
|-----------|--|----------|
| 14        |  |          |
| 15-<br>16 | WINFLUME: Getting Familiar with the Software | <b>3</b> |
| 17        | Design of Long-Throated Flume using WINFLUME | <b>3</b> |

### TEXT AND MATERIAL:

#### References Material:

1. Hydrology for Engineers, Geologists and Environmental Professionals (2nd Edition) by Sergio E. Serrano, 2010. ISBN: 9780965564342
2. Sharma R. K. and T.R. Sharma, Irrigation and Drainage, Vol-1 to V. Oxford and IBH Pub. Co.
3. Linslay R. K , and B.F. Joseph, Water Resources Engineering, McGraw Hill.
4. Siddiqui, Iqtidar H., Irrigation and Drainage Engineering, Oxford University Press
5. Punmia B.C. , "Irrigation & Water Power Engineering", Standard Publishers, Delhi
6. Garj S.K, Irrigation Engineering and Hydraulic Structures (19th Edition) 2005, Khanna Publishers, Dehli
7. FAO Irrigation and Drainage Papers

#### ASSESSMENT SYSTEM:

|                                |            |
|--------------------------------|------------|
| <b>Theoretical/Instruction</b> | <b>67%</b> |
| Assignments                    | 10%        |
| Quizzes                        | 15%        |
| Mid Semester Exam              | 30%        |
| End Semester Exam              | 45%        |
| <b>Practical Work</b>          | <b>33%</b> |
| Lab Attendance                 | 20%        |
| Lab Report                     | 20%        |
| Lab Quiz                       | 30%        |
| Lab Rubrics                    | 30%        |