

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

Center for Water Studies 204 – Applied Hydraulics

3 hours lecture, 3 units

Catalog Description

Study of the hydraulic principles involved in the operation of water and wastewater distribution and collection systems. The behavior of water in closed-conduit pressure systems and open channel delivery systems, and the types of facilities and infrastructure utilized in water and wastewater service and their operational characteristics will be explored. Students will gain advanced knowledge and understanding of complex hydraulic relationships that will facilitate troubleshooting issues and problems encountered in water and wastewater systems.

Prerequisite

None

Recommended Preparation

“C” grade or higher or “Pass” in CWS 102 or equivalent

Entrance Skills

Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:

- 1) Perform dimensional analysis and solve problems related to water and wastewater treatment, delivery and collection.
- 2) Interpret and utilize graphs, tables and formulas in the calculation of various mathematical problems commonly encountered in the water and wastewater industry.
- 3) Competence in basic math skills including algebra

Course Content

- 1) Introduction
 - a. Course objectives
 - b. Review of math required for hydraulic calculations
- 2) Hydrostatics
 - a. Head, Pressure, HGL
 - b. Pressure and head measurements
 - c. Pressure, area, and hydrostatic force
- 3) Pressure Pipe Flow
 - a. Flow Velocity
 - b. Pipe friction
 - c. Head loss
 - d. Hazen-Williams formula
 - e. Nomographs
 - f. Hydraulic system calculations
 - g. Bernoulli's equation
 - h. Continuity equation
- 4) Open Channel Flow
 - a. Manning's equation
 - b. Slope
 - c. Hydraulic radius

- d. Roughness coefficient
- e. Flow Velocity
- f. Nomographs
- g. Weirs
- h. Flumes
- 5) Pressure Pipe Flow Measurement
 - a. Volume
 - b. Displacement
 - c. Venturi
 - d. Orifice
 - e. Pitot tube
 - f. Differential pressure measurement
- 6) Pumps
 - a. Pumping principles
 - b. Types of pumps
 - c. Positive displacement
 - d. Centrifugal
 - e. Turbine
 - f. Pump drives and drivers
 - g. Pump curves
 - h. Head
 - i. Flow
 - j. NPSH
 - k. Efficiency
 - l. Power calculations
- 7) Water Distribution Systems
 - a. Gravity systems
 - b. Pumped systems
 - c. Reservoirs
 - d. Transmission mains
 - e. Distribution mains
 - f. Pressure zones
 - g. Regulator valves
 - h. Pump plant controls
 - i. Pressure relief valves
 - j. Reservoir control valves
- 8) Wastewater Collection Systems
 - a. Laterals
 - b. Collection mains
 - c. Manholes
 - d. Pump plants
 - e. Transmission mains
 - f. Metering stations

Course Objectives

Students will be able to:

- 1) Apply hydraulic terminology to explain velocity, flow and pressure in water and wastewater delivery and collection systems.
- 2) Solve equations to calculate volume, pressure, velocity, force and flow in water and wastewater delivery and collection systems.
- 3) Explain the principles of flow measurement and determine the appropriate flow measurement systems utilized in water and wastewater systems.
- 4) Apply their knowledge of hydraulics to predict the behavior of fluids in closed-conduit pressure conveyance systems and gravity conveyance systems.

Method of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements of evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

- 1) Quizzes and exams that measure students' ability to:
 - a. Explain velocity, flow and pressure relationships in water and wastewater systems.
 - b. Calculate volume, head, pressure, velocity, head loss and flow in water and wastewater conveyance systems.
 - c. Calculate total dynamic head, pump efficiency, and pumping costs related to pumping systems used in the water and wastewater industry.
- 2) Exercises that demonstrate students' ability to calculate volume, head, pressure, velocity, head loss and flow in water and wastewater conveyance systems.
- 3) Exercises that demonstrate students' ability to predict the behavior of fluids in closed-conduit and gravity conveyance systems.
- 4) Projects and assignments utilizing the Field Operations Skills Yard.

Special Materials Required of Student

None

Minimum Instructional Facilities

Smart classroom

Method of Instruction

- 1) Lecture and discussion
- 2) Multimedia presentations
- 3) Demonstrations utilizing the Field Operations Skills Yard

Out-of-Class Assignments

- 1) **Reading:** Read assigned textbook sections or instructor-provided materials on hydraulic principles, including head, pressure, friction loss, open-channel flow, and pump performance; Review charts, tables, and nomographs used for hydraulic calculations (e.g., Hazen-Williams, Manning's equation); read technical excerpts or system diagrams related to water/wastewater distribution and collection systems.
- 2) **Writing:** Complete written solutions to problem sets involving pressure, velocity, flow, head loss, open-channel flow, and pump calculations;
- 3) **Other:** Analyze real or simulated pump curves, system schematics, or flow measurement data as part of homework; prepare for quizzes and exams through additional practice with formulas, nomographs, and system-based problem solving.

Texts and References

- 1) Required (representative example): None
- 2) Supplemental: Pizzi, Nicholas. *Basic Science Concepts and Applications*. 4th edition. American Water Works Association, 2010 (Classic).

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- 1) Use hydraulic knowledge and terminology to describe the relationships between volume, velocity, flow, head loss, and pressure as they relate to water and wastewater systems.
- 2) Solve complex problems commonly encountered in water and wastewater systems using formulas and equations for volume, pressure, head loss, velocity, flow rate, hydrostatic force, pump horsepower, and efficiency.

- 3) Explain the behavior of water in closed conduit pressure systems, open channel flow systems, and pumping and storage operations, according to hydrology and hydraulic principles.
- 4) Utilize math skills and hydraulics knowledge to analyze complex hydraulic systems and calculate solutions to problems.