COURSE SYLLABUS (2 Page)

Course Number: CEGR 3143
Course Name: Hydraulics and Hydrology

Credits and Contact Hours: 3

Instructor: Jim Bowen

Textbook:
Title: Fluid Mechanics with Engineering Applications, 10th ed.
Authors: Finnemore and Franzini
Year: 2002

Other Supplemental Materials: Moodle Page

Catalog Description: Fluid properties, pressure, closed-conduit flow, pipe network, pumps, open channel flow, weirs, orifices, flumes; precipitation, runoff, groundwater flow, steam flow, flow measurement.
Most Recently Offered (Day): Spring 2017, Fall 2016, Spring 2016
Most Recently Offered (Evening): Course has not been offered in 3 years

Pre-Requisites/Co-Requisites: MATH 2171 and MEGR 2141 with grades of C or above

Course is: Required (R)

Goals: The objective of this course is to provide the student with an understanding of fluid mechanics as it applies to the environment and to civil engineering works. By the end of the class the student will be able to:

1. be able to give a definition of fluid properties such as viscosity, surface tension, and bulk modulus of elasticity, and solve equations using these properties,
2. solve equations using Newton's law of viscosity,
3. calculate the fluid pressure at any point in a fluid,
4. be able to use information on barometers and manometers to calculate pressures within a fluid,
5. calculate the hydrostatic force on flat and curved surfaces,
6. calculate the center of pressure of hydrostatic forces,
7. calculate buoyancy forces on objects,
8. understand the differences between types of fluid flow (e.g. laminar vs. turbulent, steady vs. unsteady, 1, 2, or 3-dimensional)
9. use momentum and energy equation to solve fluid flow problems,
10. understand the factors affecting fluid flows in pipes and open channels,
11. be able to use the Moody diagram to calculate friction factors in pipe flow,
12. be able to use the Bernoulli equation and the Moody diagram to solve pipe flow problems,
13. understand the difference between sub and super critical open channel flows,
14. be able to calculate the critical flow depth in open channels,

15. be able to use information on channel slope, roughness, and geometry to calculate open channel flow velocities and flow rates,
16. understand the conditions that produce a hydraulic jump,
17. calculate conjugate depths and energy losses in a hydraulic jump
18. understand how to use a pump performance curve to calculate head added and efficiency given pump flow rate,
19. calculate power requirements for operating a pump given a flow rate and a pump performance curve,
20. understand the operation of pumps in parallel and serial configurations,
21. calculate stormwater runoff given watershed and rainfall information.

Student Outcomes Addressed:

In this course, students will develop the following Student Outcomes:

A. an ability to apply knowledge of mathematics, science, and engineering

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

E. an ability to identify, formulate, and solve engineering problems

F. an understanding of professional and ethical responsibility

K. an ability to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Topics:

- Course Introduction: fluid mechanics vs. hydraulics vs. hydrology, units and dimensions
- Fluid properties: mass density, specific weight, specific gravity, specific volume, compressibility of liquids and solids, perfect gases, viscosity, surface tension, vapor pressure
- Fluid Statics: Force balances in static fluids, hydrostatics equation, absolute and gage pressures, piezometers, manometers, barometers, magnitude and location of hydrostatic forces on plane surfaces, pressure forces on curved surfaces, buoyancy forces for submerged and floating bodies
- Basics of Fluid Flow: fluid flow terms (steady, uniform, three-dimensional), laminar vs. turbulent flow, discharge, mean velocity, volume, mass, weight flow rates, steady and unsteady mass balances, velocity and acceleration in three-dimensional steady and unsteady flow.
- Energy in Steady Flow: Energies of flowing fluids, Bernoulli equation for ideal fluid, stagnation pressure, pitot tubes, venture meters, Bernoulli equation for real fluid, head, fluid power, hydraulic and energy grade line, head loss at submerged discharges
- Momentum and Forces in Fluid Flow: Forces on pressure conduits, forces of free jets, reaction forces of jets, jet propulsion
- Steady Incompressible Flow in Pipes: characteristics of laminar and turbulent flow, Reynolds number, force balance in steady flow, hydraulic radius, Darcy equation for circular and non-circular conduits, relating f to tau not, velocity distributions in laminar and turbulent flow, friction factor in turbulent flow, viscous sublayer in turbulent flow, finding f for turbulent flow, hydraulically smooth and fully rough pipes, solution methods for various problem types (head loss, discharge, pipe design), empirical flow equations, minor losses, pipes in parallel and series
- Steady Flow in Open Channels: Force balances in open channels, uniform, gradually, and rapidly varying flow, uniform flow equations, hydraulics elements chart, specific energy, alternate depths, critical flow, disturbance velocity (gravity waves), rapidly varying flow, humps and contractions, hydraulic jump, flow measurement, weirs, gates, spillways
- Hydraulic Machinery: Types of pumps, head developed by pump, pump efficiency, pump performance curves, pump operating point
- Hydrology: Hydrologic cycle, hydrologic equation, runoff prediction, rational formula, estimating runoff coefficients and concentration time