CVE 304: Hydraulics II (2 Units)

- Simulation of complex flow fields using sources, sinks, uniform flows and doublets and combination of vortices.
- Steady and unsteady flows in open channels.
- Dimension analysis and similitude.
- Hydraulic modeling techniques.
- Pipe network analysis.
- Design of reticulation systems. Unsteady flow in pipes with special emphasis

- **Lecturer: Dr. O.S. Awokola**
- Lectures: Time Table
- Tutorial: *To be decided*
- Assignments 0-5%
- Midterm 25% (likely to be 2 tests or one plus snap tests)
- Final 70%
- **References:**
- (1) Fluid Mechanics: J.F. Douglas, J.M. Gasiorek & J.A. Swaffield
- (2) Fluid Mechanics, Victor L. Streeter, E. Benjamin
- (3) Fluid Mechanics With Engineering Applications, Robert L. Daugherty & Joseph B. Franzini
- This course is intended to provide the student with the knowledge of basic principles of Hydraulics
- On completion of this course the student should be able to:

- Understand the importance of uniform flow in open channel
- Understand the importance of non-uniform flow in open channel
- Understand the importance of unsteady flow.
- Use Chezy's and Mannings equation
- Explain the concept of dimensional analysis
- List the applications of dimensional analysis
- Solve problems using principles of dimensional analysis
- Define similitude
- Explain the geometric, kinematic and dynamic similarity
- Explain the application of principles of geometric, kinematic and dynamic similarity of Reynolds and Froude Model laws

OPEN CHANNELS

- DEFINITION: Every conduit in which a flowing liquid is confined only by the sides and bottom while the surface is free.
- TYPES:

a) Natural or artificial

b) Dug in the ground with or without protective linings

c) Made of pipes

d) Rectangular, Triangular, Trapezoidal, Circular, Semi-Circular or irregular shape

- An open channel can be defined also as a conduit in which the liquid flows with a free surface subjected to atmospheric pressure.

- The flow is caused by the slope of the channel and of the liquid surface.

FLOW REGIMES

$V = \frac{Q}{A}$

$Q = VA$

Q= Discharge m^3 / s

V= Velocity m/s

A= X-Section Area (m^2)

Variation of the above values w.r.t longitudinal distance (L) and time (T) define different flow regimes

1. STEADY FLOW: defined under pipe flow as condition in which flow characteristics at any point do not change with time $\frac{dV}{dt} = 0$, $\frac{dy}{dt = 0}$
2. UNIFORM FLOW : refers to the condition in which the DEPTH, SLOPE VELOCITY and CROSS –SECTION remain constant over a given length of channel $\frac{dV}{dL} = 0$, $\frac{dy}{dL} = 0$

3. NON-UNIFORM FLOW/VARIED FLOW occurs when the depth of low occurs when the depth of flow changes along the length of the open channel $\frac{dy}{dL} \neq 0$. The velocity changes from cross-section to cross-section $\frac{dV}{dL} \neq 0$

OTHER COMBINATIONS ARE POSSIBLE

UNIFORM STEADY FLOW

The equations commonly used in calculating uniform, steady flow are

1. CHEZY EQUATION $V = C\sqrt{RS}$ V=average velocity (m/s), C=Chezy's coefficient, R=hydraulic radius=$\frac{A}{P}$, S= Bed slope of the channel.

MANNING'S EQUATION $V = \frac{1}{n}R^{2/3}S^{1/2}$ this the most widely used formula for open channel flow. Manning's n depends only on the roughness of the channel sides and bottom