Fluid Mechanics

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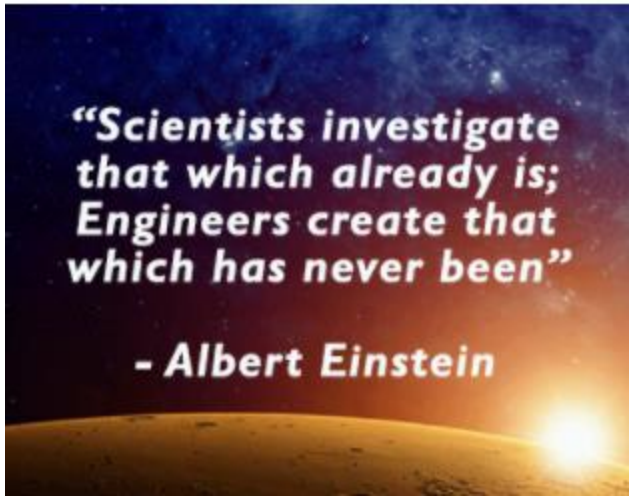
COURSE CODE: CEE 3311

COURSE TITLE: FLUID MECHANICS 1



Rationale

Fluid Mechanics is a prerequisite to most courses later in the different engineering disciplines. Understanding the fundamental laws relating to the static and dynamic behaviour of fluids is therefore important in applying fluid mechanics to solve various engineering problems.

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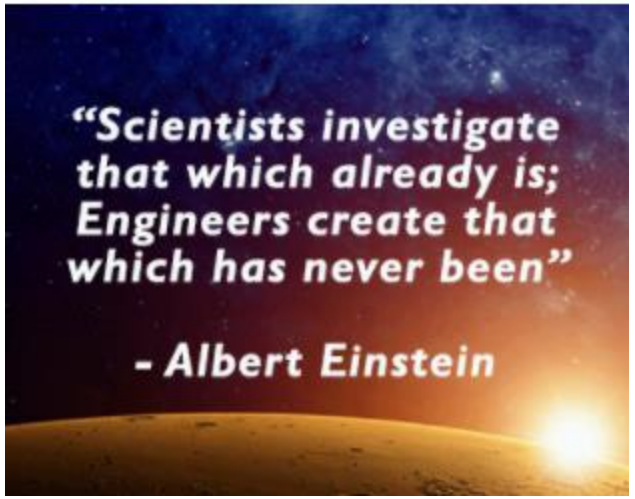

Rationale

What is engineering?

1. Engineering is a scientific field and job that involves taking our scientific understanding of the natural world and using it to invent, design, and build things to solve problems and achieve practical goals. This can include the development of roads, bridges, cars, planes, machines, tools, processes, and computers. (Study.com)
2. Engineering is the study of using scientific principles design and build machines, structures, and other things, including bridges, roads, vehicles, and buildings (Cambridge.org)
3. Engineer is one who contrives, designs or constructs electrical or mechanical plant, public works or mining work, or a tradesman, such as a mechanic or a fitter and in the USA, also the driver of any engine. (Dictionary of Civil Engineering)

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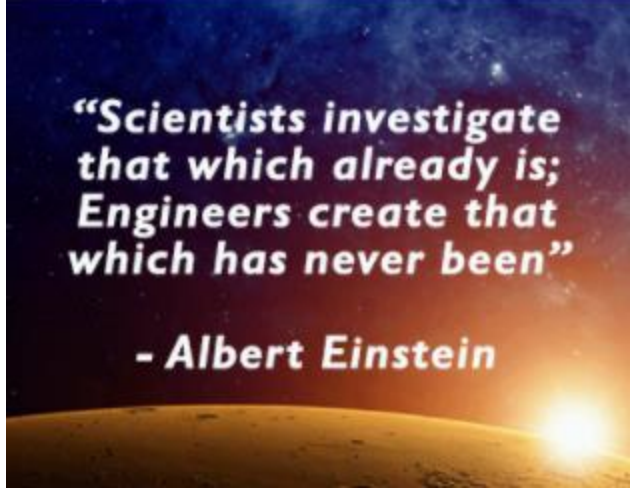

Aim

To equip students with knowledge on key concepts and fundamental principles of fluid mechanics.

Course Objectives

At the end of the course students should be able to:

1. Identify & use key concepts and fundamental principles, together with the assumptions made in their development pertaining to fluid behaviour, both in *static* and *flowing* conditions
2. Deal effectively with practical engineering situations
3. Recognise possible applications and links to other disciplines.

Course Content

Properties of fluids

Principles of FM, Fluid as a continuum, Density, Specific volume, Specific weight, Specific gravity, Viscosity, Perfect gas, Compressibility, Surface tension, Vapour pressure

Fluid Statics

Normal forces, Pressure at a point, Variation of pressure in the static fluid, Pressure expressed in height of fluid, Absolute and gage pressures, Measurement of absolute pressure, Pressure measurement in a fluid, Forces on submerged surfaces, Buoyancy and floatation

Fluids in motion

Description of fluid motion, Classification of fluid motion, Bernoulli Equation

Control volume

System and control volume, Derivation of the control volume equation**,** Derivation and application of the continuity equation and differential equation of continuity, Derivation of the energy equation, Simplified forms of the energy equation, Concept of hydraulic and energy grade lines, Derivation of the momentum equation, Application of the momentum equation

Course Content

Flow of an Ideal Fluid

Rotational and irrotational flow, The stream function, Basic flow fields, Velocity potential, Orthogonality of streamlines and equipotential lines, Use and limitations of flow nets

Flow of a Real Fluid

Forces on immersed bodies, Boundary layer, Resistance in turbulent flow, Boundary layer separation and pressure drag, Drag on two and three –dimensional bodies, application to falling sphere (Stoke's law)

Flow in Pipes (Internal Flows)

Laminar and turbulent flow, Hydraulic radius, Laminar flow (Hagen-Poiseuille's formula), Steady laminar flow in circular pipes, Turbulent flow (Darcy-Weisbach formula), Minor losses in pipe flow, Equivalent length, Loss coefficients, Pipes in series, parallel and branching, Pipe networks using Hardy Cross method

Flow in Open Channels (external flows)

Chezy and Manning's formulae, Specific energy, Subcritical and supercritical flows, Hydraulic jump, Types of open channel flow

Time:

4 hrs of lectures + 3 hrs tutorial or lab per week

Assessment

Continuous Assessment:

Assignments/quiz	5%
Labs	15%
Test	20%
Final Examination	60%

Prescribed Books

1. Potter M., Wiggert D. and Ramadan B. (2011). Mechanics of Fluids, 6th Ed., Cengage
Learning, ISBN: 1285225406, 9781285225401.
2. Franzini J.B. and Finnemore E.J. (2002). Fluid Mechanics with Engineering Applications, 10th Ed., Mc GrawHill, ISBN: 0072432020.
3. Giles R.V, Evett J.B and Liu C. (2014). Theory and Problems of Fluid Mechanics and Hydraulics, 4th Ed., Schaum's Outline Series: McGraw-Hill

Recommended Reading

1. Douglas, J. F., Gasoriek, J. M., Swaffield, J and Jack, L. (2011). Fluid Mechanics, 6th Ed: Prentice Hall, ASIN B00DJFQ4DU.

Other useful sources

1. Internet: including videos
2. DSTV: Science of Stupidity & others