Syllabus Transport Phenomena

First Course
Biomedical Engineering

Lecture 1
- Some Characteristics of Fluids
- Dimensions, Dimensional Homogeneity, and Units
- Analysis of Fluid Behavior
- Measures of Fluid (Density, Specific Weight & Specific Gravity)

Lecture 2
- Ideal Gas Law (Equations of state)
- Viscosity

Lecture 3
- Pressure at a Point (Basic Equation for Pressure Field, Pressure Variation in a Fluid at Rest, Incompressible Fluid & Compressible Fluid)

Lecture 4
- Measurement of Pressure (Manometry, Piezometer Tube, U-Tube Manometer & Inclined-Tube Manometer)

Lecture 5
- Elementary Fluid Dynamics - The Bernoulli Equation (Newton's Second Law, F = ma along a Streamline, F = ma Normal to a Streamline & Physical Interpretation)

Lecture 6
- Elementary Fluid Dynamics - The Bernoulli Equation (Static, Stagnation, Dynamic, Total Pressure & Examples of Use of the Bernoulli Equation)

Lecture 7
- Elementary Fluid Dynamics - The Bernoulli Equation (Free Jets)
- Elementary Fluid Dynamics - Confined Flows
- Elementary Fluid Dynamics - Flowrate Measurement
- Elementary Fluid Dynamics - The Energy Line and the Hydraulic Grade Line

Lecture 8
- Dimensional Analysis – (Buckingham Pi Theorem, Determination of Pi Terms, Some Additional Comments about Dimensional Analysis & Determination of Pi Terms by Inspection)

Lecture 9
- Viscous Flow in Pipes
  - 8.1 General Characteristics of Pipe Flow
    - Laminar or Turbulent Flow
    - Entrance Region and Fully Developed Flow

Lecture 10

➢ Viscous Flow in Pipes - Pressure and Shear Stress (Fully Developed Laminar Flow, From F = ma Applied Directly to a Fluid Element, From Dimensional Analysis & Energy Considerations)

Lecture 11

➢ Viscous Flow in Pipes - Dimensional Analysis of Pipe Flow (Major Losses & Minor Losses)

Lecture 12

➢ Viscous Flow in Pipes - Pipe Flow Examples (Single Pipes & Multiple Pipe Systems)
➢ Viscous Flow in Noncircular Conduits

Lecture 13

➢ Pipe Flow Examples - Pipe Flowrate Measurement (Pipe Flowrate Meters & Volume Flowmeters)