Chemical Engineering 374

Fluid Mechanics

Final Review (from Exam 3 on)

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Exam 1

- Classes 1-9 (plus review)
- Chapter 1 Introduction/Basics
- Chapter 2.1-2.6 Fluid Properties
- Chapter 3.1-3.6 Pressure/Fluid Statics
- Chapter 4.1, 4.6 RTT, Conservation Laws
- Chapter 5.1-5.5 M.B., E.B., Bernoulli
- Homeworks 1-9

Exam 2

3

- Classes 13-21
- Chapter 5.6 Mechanical Energy
- Chapter 7.1-7.5 Dimensional Analysis
- Chapter 8.1-8.8 Pipe Flows
  - Laminar
  - Turbulent
  - Minor Losses
  - Single Pipelines
  - Pipe networks
  - Flow measurement
- HW 10-18

Exam 3

4

- Classes 25-32 (plus review)
- Chapter 6.1-6.4 Momentum Balance
- Chapter 9.1-9.2, 9.4-9.6 Differential Balances
- Chapter 10.6 Boundary Layers
- Chapter 14.1-14.5 Pumps and Turbines
- HW 19-27

Final Exam

- All previous material plus:
- Classes 36-40
- Notes Non-Newtonian Flow
- Chapter 12 Compressible Flow
- Chapter 15 CFD
- HW 28, 29

Class 36—Non-Newtonian Flow

- Types of NN fluids and examples
- Power law fluids—Form of tau
- Laminar pipe flow
  - Redo equations for a new tau expression
    - Important themselves, and to get Re and f expressions.
  - Define Re as 64/f,
- A non-Newtonian "Moody" chart
- Analyse as for Newtonian flows
- Rhelological parameters (get the K and n)

Class 37—Compressible Flows

- Sound speed: derivation and equation:
  c=sqrt(kRT/M)
- T, P, rho expressions for compressible flows versus speed (Mach number).
  - Found using an energy balance from a reservoir.
- Flow in nozzles: mdot = rho*A*v
  - Mach > 1 requires a diverging nozzle for increasing speed.
  - Area versus flow in a nozzle
- Choked flow: pressure ration = 0.53

Class 39-40—CFD Intro

- Know material covered by the book/reading questions
  - 15.1, 15.3
  - Grid types and properties
  - Boundary conditions
- Turbulent simulation approaches: RANS, DNS, LES
  - Why are turbulent flows hard to simulate
  - Most popular turbulence model for RANS = k-epsilon
- Example solution of unsteady 1-D laminar flow
- Example of a 2-D laminar jet and lid-driven cavity
- *Turbulence → average properties → term for the unresolved fluctuations → require "closure" (meaning writing the <v'v'> average term in terms of things we are solving (v average). → turbulent viscosity → k-epsilon model.*