Chemical Engineering Fluid Mechanics Schedule of Topics Spring 2016 Revised 3/18/2016

**Topic List & Course Schedule (Tentative)**Tuesday 08:00 AM - 10:45 AM ROW 340 (Double Period)  
Friday 08:00 AM - 9:15 AM ROW 340 (Single Period)

1. *Fluid Mechanics for Chemical Engineers*, 3rd Ed. By Noel de Nevers, McGraw-Hill, 2005.
2. *Problem Solving in Chemical and Biochemical Engineering with POLYMATH, Excel, and MATLAB* (2nd Edition), Publisher: Prentice Hall PTR; (September 22, 2007) ISBN-10: 0131482041 or ISBN-13: 978-0131482043, by Michael B. Cutlip and Mordechai Shacham. (**C&S2nd** )

Polymath: Nonlinear Equation Solver (NLE)

Polymath: Differential Equation Solver (DEQ) & COMSOL

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| Date | Topics |
| **January**  19 Tuesday | **Introduction to Course, Objectives, Syllabus** Team Problem Solving, Inductive Topic Order Chemical EngineersMechanical Engineers (eqn 2.7) **Fluids Lab 1: Introduction to Fluids Experiments** **Chapter 2** Fluid Statics Sections 2 - 2.2, 2.6, 2.7 and **Chapter 5 Elementary Fluid Dynamics** (Also review Felder & Rousseau Section 3.1-3.4 Fluid Pressure, Hydrostatic Head, Manometers) |
| 22 Friday | **Fluid Flow without accounting for friction**  **Review of Intro to Fluids lab Chapter 2 & Chapter 5** – The Bernoulli Equation - Neglecting Friction!  Felder & Rouseau 7.7 Mechanical Energy Balances, eqn 7.7-1 3.5 Unsteady-State Mass Balances |
| 26 Tuesday | 3.5 Unsteady-State Mass Balances(continued) 3.4.1 Average Velocity Applications of Unsteady-State Mass Balances and Bernoulli’s Equation  Tank Drainage Problem **Fluids Lab 2: Tank Drainage & Siphon Experiments** |
| 29 Friday | Applications of Bernoulli’s Equation continued:  5.5 Diffusers and Sudden Expansions, , |
| **February** 2 Tuesday | **Fluids Lab 3:  F1-15 Bernoulli’s Theorem – venturi**  **F1-17 Orifice and Free Jet Flow Pressure Drop in Pipes**: Hampden **Computer Lab: Introduction to POLYMATH Laboratory** |
| 5 Friday | 5.8.3 Venturi, and Restrictions on the Use of the Bernoulli Equation  5.8.1&5.8.2 Pitot tube |
| 9 Tuesday | **Chapter 6 Viscous Flow in Pipes**  Incompressible Flow in Pipes and Channels  Figure 6.10: Friction Factor Chart 6.1 Reynolds Number (*Re)* and viscosityμ Cutlip&Shacham 8.7 Comparison of Friction Factor Correlations for Turbulent Pipe Flow  Cutlip&Shacham 8.8 Calculations Involving Friction Factors for Flow in Pipes |
| 12 Friday | 6.5 Pipe Flow Problems – fanning friction factor Example problems: **simple piping** Standard Steel Pipe Properties: Appendix A.2 page 598,  Standard Tube Properties: Cutlip & Shacham p699, Chemical Engineer’s Handbook has both |
| 16 Tuesday | **Fluids Lab 4:  Pressure Drop in Pipeline Elements: Hampden F1-22 Energy Losses in Bends and Fittings  Osborne-Reynolds Demonstration Computer Lab - Excel** |
| 19 Friday | 6.8 & 6.9 Minor Pressure Losses. Frictional Losses in Pipeline Elements Perry’s p6-16 ( See Table 6-4 for turbulent, Table 6-5 for laminar, )  Review for Exam 1 Cutlip&Shacham 8.10 Calculation of the Flow Rate in a Pipeline  Cutlip&Shacham 8.14 Optimal Pipe Length for Draining a Cylindrical Tank in Turbulent Flow Cutlip&Shacham 8.14 Optimal Pipe Length for Draining a Cylindrical Tank in Laminar Flow |
| 23 Tuesday | 6.13 Terminal Velocities Solid Objects and Spheres **Fluids Lab 5:  Lab: Measurement of Terminal Velocities** |
| 26 Friday | **Exam 1: Chapters 2 and 5** |
| **March** 1 Tuesday | Terminal Velocity Continued |
| 4 Friday | 6.2 Laminar and Turbulent flow 6.3 Laminar Flow Velocity Profile Entrance Region and Fully Developed Flow |
| 8 Tuesday | 6.10.3 Tubulent Flow in Noncircular Channels 6.10.2 Seal Leaks 6.12 Economic Pipe Diameter, Economic Velocity |
| 11 Friday | **Introduction to Pipe Flow Rate Measurements: orifice, venturi and** **rotameter** Permanent and Temporary Pressure Loss How to purchase a Flowmeter 5.8: Bernoulli Equation Perry’s 10-6 to 10-20 Measurement of Flow |
| **14-19** | **Spring Break** |
| 22 Tuesday | **Chapter 7: Mass, Energy, and Momentum Balances** 7.2 Momentum Balance Typical Forces: gravity, Pressure and Wall Shear Stress  **Fluids Lab 6: Flowmeters: Rotameter – Variable Area Flowmeter, Venturi. Orifice, Pitot tube** |
| 25 Friday | Good Friday: No Classes |
| 29 Tuesday | 7.3 Momentum Balances Applications: Flow Through a Nozzle (Example 7.5), U-Bend in piping, Reducing Elbow, Jet Ejector Pump (7.3.5)  Macroscopic Control Volume: Pressure drop and Wall Stress |
| **April** 1 Friday | Microscopic Control Volume – Derivation of laminar flow velocity profile Examples of the Momentum Balances: Alpha term in Bernoulli Equation & Diameter of a Free Jet |
| 5 Tuesday | Examples of the Momentum Balance Continued: Impinging jet, Orifice Plate, Sudden Expansion, 7.4 Relative velocities & Trolley Example  Review for Exam,  **Impact of a Jet Videos** (See the Force of water) |
| 8 Friday | **Exam 2: Chapter 6 and 5.8: Pipe Flow, Fittings & Valves, and Flowmeters** |
| 12 Tuesday | Examples of the Momentum Balance Continued : Rotameter (also see Chapter 6 in Denn), 6.10.3 Turbulent flow in Noncircular Channels  **Fluids Lab 7:** **Aspirator laboratory** |
| 15 Friday | 7.5 Starting and Stopping Flows: Water Hammer |
| 19 Tuesday | 7.7 Introduction to Angular Momentum |
| 22 Friday | **Chapter 9: Dimensionless Numbers and Dimensional Analysis** |
| 26 Tuesday | Chapter 9: Dimensionless Numbers and Dimensional Analysis (continued) **(3rd floor computer lab not available)** |
| 29 Friday | Review for Comprehensive Final Exam |
| **May** | Final Exam 3 May 2016   |  |  |  | | --- | --- | --- | | CHEM ENGINEER FLUID MECHNICS | Hesketh, Robert Paul | T 0800 1000 ROWAN 340 (Exam) |   Go out and design a fluid transport system for your parent’s fountain and pond |