ta3220 Final Exam - Rules and Advice

Rules for the exam:

You can bring *FT* text, the *Data Companion*, your course notes (course notes handed out and those you took in class), a calculator (no computers) and up to 8 pages (A4, both sides OK) of your *own* handwritten notes (not photocopied from a colleague). The key to preparing for this exam will be compiling your own notes to organize your understanding of the material in the course notes and text. The 8 pages should act as an index to where to find details in your course notes, plus brief summary of the most important points to remember. I strongly urge you to (a) collect and organize your course notes; (b) obtain any missing notes from the web, and (c) bind the pages together, e.g., in a ring binder. Then attach your 8 pages to the front of this.

The tn4780 class had a one-page list of key equations, I understand. If you find this helpful, you can substitute this for one of your 8 pages of your own notes. For the purposes of ta3220, you *may* write on this page if you like.

No sharing of texts or course notes will be allowed during the exam.

You may *not* bring in other texts or the solutions to homework problems that were handed out in class. You may of course summarize any hints you take from the homework solutions in the 8 pages of notes you are allowed to bring in addition to the class notes. But these must be in your own handwriting; you may not simply photocopy the solutions to homework problems as part of your 8 pages. Also, you are not to photocopy someone else's course outline. You may not bring the laboratory handouts to the exam, but you can of course summarize the exercises in your 8 pages.

Note that friction-factor charts for tube, flow around sphere, and flow through packed bed are in your *FTI* text. Some shell-balance derivations are there as well. So are some charts for unsteady conduction and useful equations for heat transfer in tubes. If the FTI text teaches another (correct) way to solve a problem than that we learned in class, it is OK to use that method. However, you must explain clearly what equation or chart you are using (including the page and equation number) in your solution to the exam.

Material covered in the final exam:

Fluid Mechanics

Constitutive Equations

- Newton's "Law"
- Bingham plastic
- Power Law
- "Effective Viscosity" of a non-Newtonian fluid sheared between plates

Shell Momentum Balances

- Approach
- Final Equations flow rate and velocity profile for laminar flow of
  - Newtonian fluid, Bingham plastic and power-law fluid in cylindrical tube & slit
  - Newtonian fluid in annulus, and approximation for BP and PL fluids in annulus
  - solid particle settling in Newtonian fluid; suspension of Bingham plastic

Transition of Flow of a Newtonian Fluid from Laminar in Terms of Re

Correctly accounting for gravity in total flow potential

Consequences of Turbulence
Friction Factors
- Definitions and derivations for tube and sphere
- Tube Flow
  - Hydraulic-Radius Approximation
- Falling Sphere
- ... solution method if Re is not known
- Packed Bed
  - equation for flow at any Re
  - estimate of permeability for a packed bed
  - chart: Re at which Darcy's law becomes inaccurate

Heat Transfer

Shell-balance method for setting up the differential equation and boundary conditions for simple heat-transfer problems; solution of resulting equation for simple problems

Final equations for steady-state heat conduction through multiple planar or cylindrical layers

Multivariate and Unsteady Conduction
- Assumptions
- Derivation of pde
- Tabulated 1D Solutions
- Extending Tabulated 1D Solutions
  - surfaces where q=o
  - orthogonal conduction ("product method")
  - time-varying boundary conditions: superposition

Analysis of Complex Heat-Transfer Problems
- Approach
- Making best estimate of answer
- Estimating nature of deviations of true answer from estimate

Heat-Transfer Coefficients for Tube Flow
- combining heat transfer within a tube with conduction through the tube walls

Mass Transfer

Unsteady and Multivariate Diffusion
- Analogy to heat transfer and application of methods of unsteady conduction

"Complex" mass-transfer problems

Mass-Transfer Coefficients for Tube Flow

Laboratory Exercises

You may be asked simple questions about the laboratory exercise to see if you understand the concepts behind the exercise.

A more complete outline of material covered in class has been provided with the lecture notes.