Exam 1

- Average 88.4%
  - 92% on Problem 1 (units)
  - 87% on Problem 2 (pressure)
  - 91% on Problem 3 (DOF)
  - 84% on Problem 4 (transient)
- Key is posted on learning suite
- 24 hr cooling-off period before talking to me about the exam
- I grade on a floating curve

Please Note How the Exam Questions Followed the Competencies!

- Students will be able to use basic engineering units in both SI and AES systems in solving problems, and be able to convert between unit systems by hand
- Students will be able to solve steady-state, overall material balances for systems which include one or more of the following: recycle, multiple units
- Students will be able to set up and solve simple transient material balances
- Students will be able to use a degree-of-freedom approach to assist in the solution of material balances
- Students will be able to solve simple fluid statics problems (e.g., manometers, fluid head, etc.)

Note: These concepts are fair game in future exams and on the final!

Hope for Those with Low Scores

- Person with highest score on the final receives an A
- There are lots of points still to be achieved on homework and the case study
- 2 more exams and the final

Computers

- I encourage you to use Excel or Mathcad for as many homework problems as possible for the rest of class
  - The Case Study is coming…..

Homework Hints

- Please see the homework hints for problem 4.50!
  - This is a workbook problem
  - DO the algebra by hand – it is pretty easy

TA Note

- TA’s may move to the CAEDM computer lab on the 4th floor of the Clyde Bldg during TA hours
  - We want you to start using the computer for homework problems
Dean’s Lecture Credit

- Dean’s lecture credit
  – General Bostick, U.S. Army Corps
  • Tomorrow, 11 am, JSB Auditorium

Notify the TAs somehow
  – A note on your homework
  – Email
  – TA hours
  – Separate sheet

Balances with Reactions

Class 13

Class Quiz:

(a) What is the equation for the %excess of a reactant?

(b) What is equation for the fractional conversion?

(c) What is the equation for the extent of reaction?

ADVICE

➢ Work through the examples in sections 4.7, 4.8
  • Ex 4.7-1 thru 3 (today)
  • Ex 4.8-1 thru 4 (for next time)

➢ Don’t just browse through!

(Otherwise you will not learn this material)

3 Different Methods of Balances for Reacting Systems

1. Molecular Species Balances
2. Atomic Element Balances
3. Extent of Reaction

1. Molecular Species Balances (reacting systems – used least)

• Use generation and consumption terms
• Use ratios of species based on stoichiometry
  – Moles species j generated/moles species i consumed
• Add # of independent chemical rxns to DOF analysis
  + # of unknowns
  + # of independent chemical reactions
  - # of independent molecular species balances
  - # of other equations
  = DOF
2. Atomic Element Balances
(reacting systems – useful)

- No generation and consumption terms
  \( \text{In} = \text{Out} \)
- Count moles of atoms
  - Split up species into atoms
- Add # of independent atomic element balances to DOF analysis
  
  \[
  + \# \text{ of unknowns} - \# \text{ of independent atomic element balances} - \# \text{ of independent non-reacting molecular species balances} - \# \text{ of other equations} = \text{DOF}
  \]

3. Balances Using Extent of Reaction
(useful)

- Use definition of \( \xi_i \)
  \[
  \text{n}_i = \text{n}_{i,o} + \text{v}_i \xi_i
  \]
  or using flow rates
- One \( \xi_i \) for each reaction
  - Use problem info to get \( \xi_i \)’s, then calculate unknown variables
- Add extent of reaction variables to DOF analysis
  
  \[
  + \# \text{ of unknowns} + \# \text{ of independent } \xi_i \text{'s} - \# \text{ of independent reacting molecular species balances} - \# \text{ of independent non-reacting species} - \# \text{ of other equations} = \text{DOF}
  \]

Recommendations

- Book recommends element balances (I agree)
  - If not, try extent of reaction approach

Caution:
- Element balances are not always independent!!!
  - If ratio of two elements is constant everywhere, the element balances are not independent!

Example Problem

- If no reactions occur in the subunit, use the DOF for non-reacting systems
- If reactions occur in the overall system, you must use the DOF for reacting systems for the overall system
Example Problem
with zero DOF

Additional Relationships:
1. 65% conversion of C₃H₈
2. 25% excess H₂O