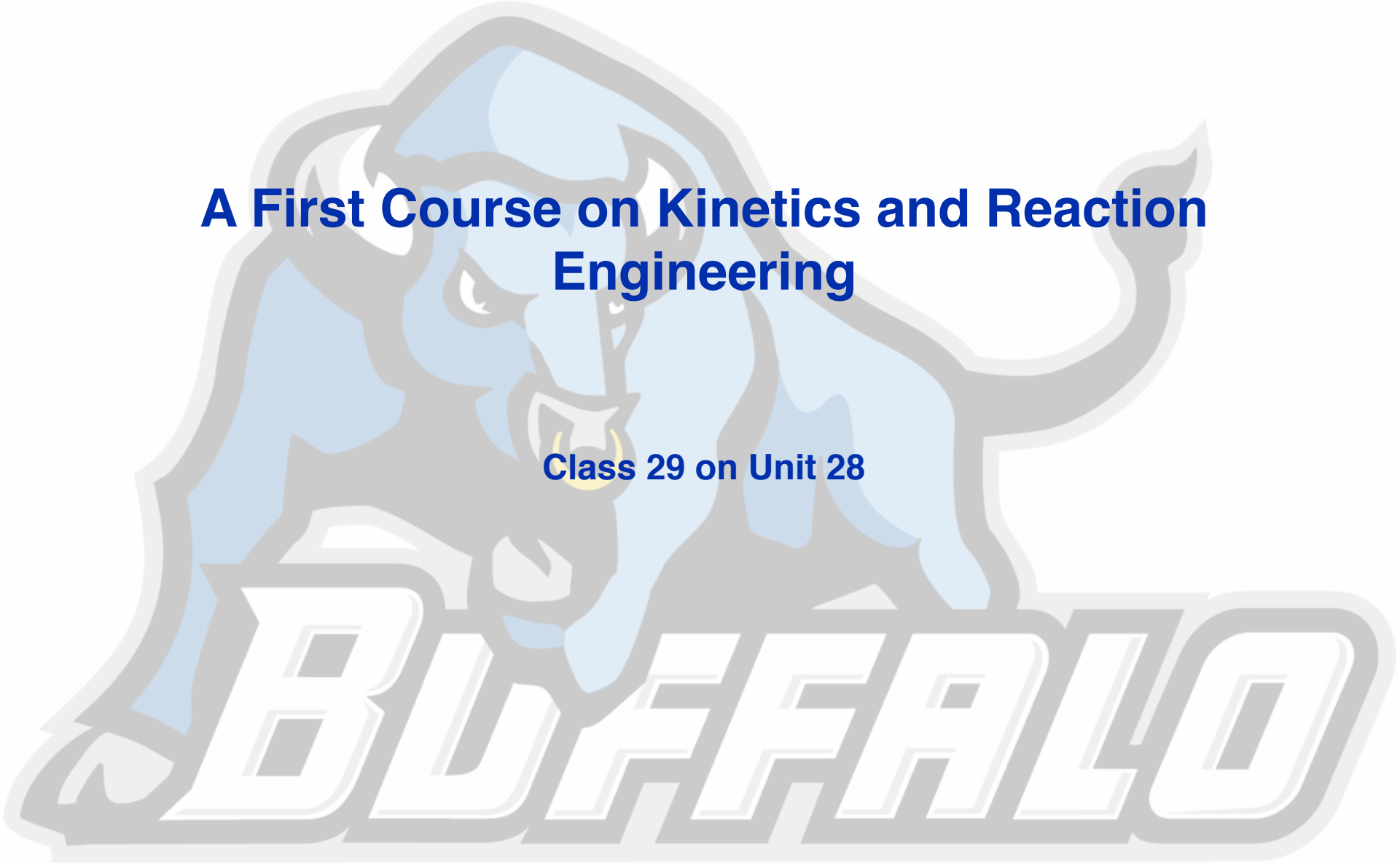
A First Course on Kinetics and Reaction Engineering

Class 29 on Unit 28



Where We're Going

- Part I - Chemical Reactions
- Part II - Chemical Reaction Kinetics
- Part III - Chemical Reaction Engineering
  - A. Ideal Reactors
  - B. Perfectly Mixed Batch Reactors
  - C. Continuous Flow Stirred Tank Reactors
  - D. Plug Flow Reactors
  - E. Matching Reactors to Reactions
    - 28. Choosing a Reactor Type
    - 29. Multiple Reactor Networks
    - 30. Thermal Back-Mixing in a PFR
    - 31. Back-Mixing in a PFR via Recycle
    - 32. Ideal Semi-Batch Reactors
- Part IV - Non-Ideal Reactions and Reactors

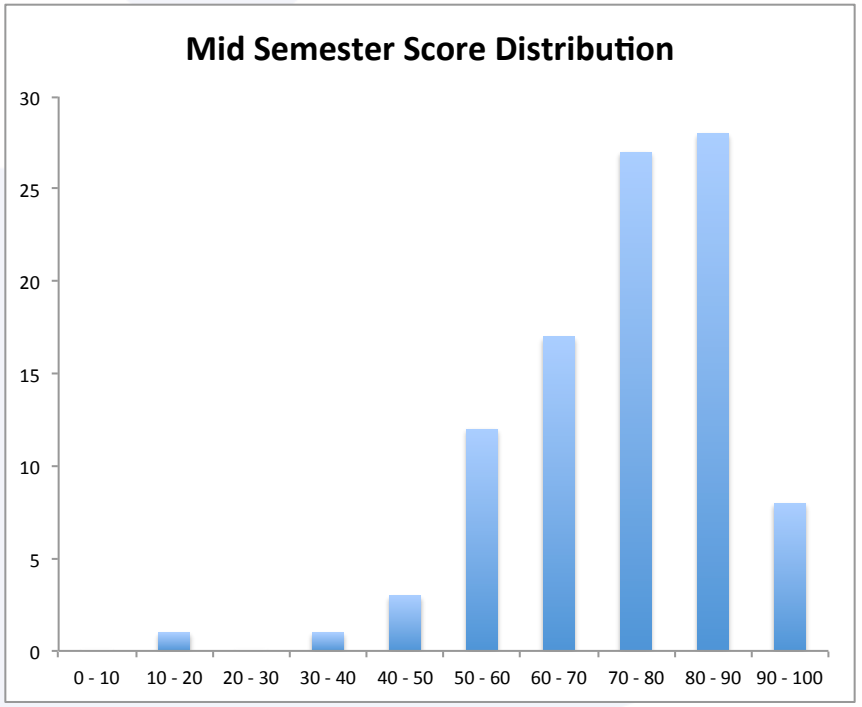
Selecting a Reactor Type

- First Considerations
  - Safety: Are any of the ideal reactor types inherently risky with respect to safe operation?
  - Practicality: Can any of the ideal reactor types be eliminated from consideration for practical reasons?
  - Existing technology: Is this reaction system, or one that is chemically similar, already being operated commercially?
- Batch *versus* Continuous
  - Batch processing is more labor intensive and costly than continuous
    - Best for chemicals where the total amount to be produced is small and the price of the product is high
    - Pharmaceuticals and specialty chemicals
  - Continuous processing
    - Best when the amount to be processed is large
    - Commodity chemicals
- CSTR *versus* PFR
  - In a CSTR, the reaction only takes place at the final conditions
    - low reactant, high product
  - In a PFR, the reaction starts at the inlet conditions and occurs at continually changing conditions, only reaching the CSTR conditions at the end of processing
    - high reactant, low product
- Trade offs
  - When one ideal reactor type is not clearly preferred, a quantitative analysis of both may be warranted
  - This will be necessary for the selected reactor even if there are no trade-offs
  - Augmented ideal reactors may offer advantages
  - Adding another piece of equipment or flow line to an ideal reactor type can cause it to behave differently than the ideal reactor type would by itself

Questions?

Mid-Semester Scores

- Calculation of Mid-Semester Score
  - 5% - Quizzes (Units 2-25)
  - 5% - Worksheets (through 10/30/15)
  - 5% - Homework Effort (1 - 17, 19 and 21)
  - 5% - Homework corrections (1 - 17, 19 and 21) and surveys (1 - 22)
  - 10% - MATLAB Assignments (1 - 3)
  - 60% - Exam 1
  - Renormalize result to 100 points
- Grades
  - 90 - 100 = A
  - 80 - 89 = B
  - 70 - 79 = C
  - 60 - 69 = D
  - 11.1 - 59 = F
- Statistics
  - Average: 73.6
  - Standard deviation: 14.1
  - High: 99.2
  - Low: 11.1



Where We're Going

- Part I - Chemical Reactions
- Part II - Chemical Reaction Kinetics
- Part III - Chemical Reaction Engineering
  - A. Ideal Reactors
  - B. Perfectly Mixed Batch Reactors
  - C. Continuous Flow Stirred Tank Reactors
  - D. Plug Flow Reactors
  - E. Matching Reactors to Reactions
    - 28. Choosing a Reactor Type
    - 29. Multiple Reactor Networks
    - 30. Thermal Back-Mixing in a PFR
    - 31. Back-Mixing in a PFR via Recycle
    - 32. Ideal Semi-Batch Reactors
- Part IV - Non-Ideal Reactions and Reactors

Exam 2

- All procedures will be the same as Exam 1
- There will be 6 short answer questions worth 5 points each
- There will be 2 quantitative reaction engineering problems worth 35 points each

Solution to the Practice Exam

- Posted with other solutions to homework problems