COLLEGE OF CHEMISTRY COURSE GUIDE (../INDEX.HTML)

BIOE 104 - BIOLOGICAL TRANSPORT PHENOMENA (4 UNITS)

COURSE OVERVIEW

SUMMARY

- A very helpful and holistic website about BioE 104 by one of the mean course developer and lecture Prof. Terry Johanson with syllabus, slides, and lecture notes:Link (http://www.terrydjohnson.com/BioE104)
- (From syllabus) BioE 104 “develops and applies scaling laws and the methods of continuum mechanics to biological transport phenomena over a range of length and time scales”. It will enable the students to “understand the fundamentals of mass transfer” and “apply that knowledge to biological systems and to engineering design”.
- Weekly problem sets with COMSOL lab assignments
- One midterm and one final
- One group project including a poster session and a paper

PREREQUISITES

MATH 53 (math53.html), MATH 54 (math54.html), PHYS 7A (phys7a.html)

TOPICS COVERED

- Diffusion of mass (Truskey, 2nd edition, Chapters 1, 6, 8.1 - 8.2; skip Diffusion from a point source, 6.8.3, and 6.9)

    - Random Walk
    - Fick's Laws
    - Stokes-Einstein and Wilkie-Chang
    - Steady-state 1D diffusion in Cartesian, cylindrical, and spherical coordinates
    - Unsteady 1D diffusion in a semi-infinite medium
    - Unsteady 1D diffusion in a finite medium
    - Quasi-steady diffusion
- Diffusion and conservation of momentum (Truskey, 2nd edition, Chapters 2, 3, 4.4-4.6; skip 2.8, 3.5)
    - Newtonian and non-Newtonian shear in fluids
    - The Navier-Stokes equation
    - Dimensional analysis
    - Stokes' flow
    - Bernoulli's principle
- Diffusion and Convection (Truskey, 2nd edition, Chapters 3.5-3.6, 4.4-4.6, 7.1-7.3, 7.6, 7.8-7.9)
    - 1D diffusion and convection
    - Short contact time solution
    - Mass transfer coefficients
    - Co- and countercurrent mass transfer
- Diffusion and Reaction (Truskey, 2nd edition, Chapters 6.9, 10)
    - Diffusion- and reaction-limited adsorption
    - Reaction on and convection to a surface
    - Reaction and diffusion in a volume

WORKLOAD

COURSEWORK

- Weekly problem sets with COMSOL lab assignments
- One midterm and one final
- One group project including a poster session and a 6-page paper
    - Mostly randomly assigned to a 4-member team
    - Can pick topics in a wide range within the following three options:
        - Create a new model for a biological system or device using data from the literature

- Use a model to design a novel experiment or therapeutic device
- Improve upon an existing model system from the literature

TIME COMMITMENT

3 hours of lecture and 3 hours of laboratory per week

- Lectures were mostly derivations and either follow or modify from Prof. Terry Johnson's notes (on the website)
- COMSOL labs were more or less following the manual and model problems as instructed (~ 7 labs in total)

Weekly problem sets usually have 3-5 questions (~ 12 problem sets in total)

- Mainly derivation questions, applications, and COMSOL lab-based questions

The project can take up lots of time

CHOOSING THE COURSE

WHEN TO TAKE

Spring only.

This course fulfills the Chem/ChemBio allied subject or the ChemE engineering elective

WHAT NEXT?

- BIOE 102 - Introduction to Biomechanics: Analysis (bio102.html)
- BIOE 121 - BioMEMs and Medical Devices (bioe121.html)
- Transport Processes (cbe150a.html)
- Transport and Separation Processes (cbe150b.html)

ADDITIONAL COMMENTS AND TIPS

This course was originally part of BioE 102 introduced by Prof. Mofrad and then it was divided into BioE 102 (solid mechanics) and BioE 104. Prof. Terry Johnson was the main person teaching this course and he is an amazing lecturer.

Prof. Aaron Streets sometimes would teach the course following Prof. Terry Johnson's material but would add his perspective. He really cares about individual students and tried to help whenever he could.

Both of them pay more emphasis on understanding and the process instead of the results.

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COLLEGE OF CHEMISTRY PEER SERVICES

Made by Angela Lee, c/o 2019

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