



CIV E 729 – MASS TRANSFER IN ENVIRONMENTAL ENGINEERING

INSTRUCTOR

Yaman Boluk

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OFFICE HOURS (*tentative*)

Tuesday (2:00PM to 3:00PM)

Donadeo ICE 7-273

LECTURE TIME & LOCATION

Tuesday and Thursday (9:30AM to 10:50AM)

NRE 2-122

GRADE DISTRIBUTION

Final Examination	40 %
Mid-Term Examination	30 %
Assignments (<i>2 in total</i>)	30 %

RECOMMENDED TEXTBOOKS

S. Socolofsky, G. Jirka, Environmental Fluid Mechanics Part I: Mass Transfer and Diffusion;

Logan, Bruce E., Environmental transport processes. John Wiley & Sons, 2012.

Bird, R. B., Stewart, W. E., & Lightfoot, E. N. (2006). Transport phenomena (Vol. 1). Wiley & Sons

Tosun, Ismail. Modelling in transport phenomena: a conceptual approach. Elsevier, 2007.

COURSE DESCRIPTION

Principles and applications of mass transfer relevant to environmental engineering. Topics include molecular diffusion, convective mass transfer, film and penetration theories, mass transfer coefficients, interphase transport (gas–liquid, liquid–solid), adsorption, reactive transport and biodegradation, transport in porous media, residence time distributions, membrane processes, and design/scale-up of environmental unit operations. Lectures, problem sets, lab/field exercises, and a design/project component.

LEARNING OUTCOMES

- Derive and apply governing equations for molecular diffusion and convective mass transport in relevant systems.
- Use dimensional analysis and correlations to estimate mass transfer coefficients in environmental unit operations.
- Analyze and model interphase mass transfer (gas-liquid, liquid-solid) using film and penetration theories.
- Model reactive transport includes biochemical and chemical reactions in water and subsurface environments.
- Analyze transport in porous media, including dispersion, advection, diffusion, and retardation.
- Integrate theory and experimental data to size or evaluate environmental mass-transfer units (e.g., aerators, packed columns, membranes, bioreactors).

ASSIGNMENTS

- Assignments are to be uploaded to the dropbox on Canvas by 4:30 pm on the due date.
- Late assignments will be penalized at the rate of 20% of the total grade per day.

COURSE OUTLINE

Topics	# of lectures
1. Introduction. Course outline, objectives, units and dimensions, basic concepts.	1
2. Equation of Continuity	3
3. Diffusive Transport	2
4. Mass Transfer with Advective-Diffusion.	3
5. Solving mass transfer problems	1
Review of Topics 1 and 2 for the midterm exam	1
Midterm February 12, 2026 Exam covers Topics 1 and 2	1
6. Mass Transport from Theory to Scaling Analysis and Engineering Correlations Transport Processes	
6.1. Mass Transfer Coefficient and Sherwood Number	2
6.2. Mass Transfer Models and Analogies	2
6.3. Evaluation of Transfer Coefficients	2
7. Coagulation	2
8. Kinetics of Coagulation	2
9. Particle Transport in Porous Media	3
10. Biological Systems	1
Final Exam	