
MEC 509 Transport Phenomena

Fall 2023

Prof. Carlos E. Colosqui

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Lectures: Thursdays 2:30-5:20 PM @ LGT ENGR LAB 154

Office Hours (online via zoom): Thursdays 12:30PM-2:15PM & Fridays 9:30-10:30AM or in-person by appointment.

Course Topics: Fundamentals of mass, momentum, and energy transport in isothermal and non-isothermal systems. The physical origin and meaning of transport coefficients such as shear viscosity, mass and heat diffusivity. Physical and mathematical derivation of transport equations and conservation laws for solving engineering problems. Fickian and Non-Fickian diffusion. Transport processes in multiphase and interfacial systems. Fundamentals of non-equilibrium thermodynamics, Onsager reciprocal relations. Special topics in micro/nanoscale systems and energy conversion if time permits. **Emphasis will be placed on the connection between macroscopic descriptions based on partial differential equations and the modeled microscopic physical phenomena.**

Credits: 3

Grade: A-F; Final project 40% + Midterm exam 30% + Homework assignments 30%

Tentative Lecture Schedule

week	Topic
1	Transport processes: Physical phenomena and mechanisms
2	Derivation of transport equations and conservation laws I
3	Derivation of transport equations and conservation laws II
4	Isothermal systems I: 1D problems
5	Isothermal systems II: 2D-3D problems
6	Isothermal systems III: Turbulent flows
7	Isothermal systems III: Multiphase/multicomponent systems
8	Non-isothermal systems I: 1D problems
9	Non-isothermal systems II: 2D-3D problems
10	Non-isothermal systems III: Turbulent flows
11	Non-isothermal systems III: Multiphase/multicomponent systems
12	MIDTERM EXAMINATION
13	Special Topics: Fundamentals of non-equilibrium thermodynamics
14	Special Topics: Transport phenomena in energy conversion & storage

Textbook (NOT required)

Transport Phenomena; by R. Byron Bird, Warren E. Stewart and Edwin N. Lightfoot, Wiley.

Course Learning Outcomes/Objectives

Upon completion of this course, students will be able to:

1. Understand fundamental mechanisms of mass, momentum, energy, and charge transport
2. Understand how to apply transport equations to solve engineering problems
3. Understand assumptions involved in deriving continuum-based transport equations
4. Model and solve analytically problems involving transport in systems with multiple phases, components, and interfaces.
5. Model and solve problems involving transport in turbulent flows

Learning Objectives

The learning objective of this course is to (1) learn the fundamentals physics involved in mass, momentum, and energy transport and (2) learn the analytical techniques required to solve transport equations for relevant problems in engineering, chemistry, and physics.

STUDENT ACCESSIBILITY SUPPORT

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, Stony Brook Union Suite 107, (631) 632-6748, or at sasc@stonybrook.edu. They will determine with you what accommodations are necessary and appropriate. All information and documentation is confidential. Students who require assistance during emergency evacuation are encouraged to discuss their needs with their professors and the Student Accessibility Support Center. For procedures and information go to the following website: <https://ehs.stonybrook.edu/programs/fire-safety/emergency-evacuation/evacuation-guide-disabilities> and search Fire Safety and Evacuation and Disabilities.

ACADEMIC INTEGRITY STATEMENT:

Each student must pursue his or her academic goals honestly and be personally accountable for all submitted work. Representing another person's work as your own is always wrong. Faculty is required to report any suspected instances of academic dishonesty to the Academic Judiciary. Faculty in the Health Sciences Center (School of Health Professions, Nursing, Social Welfare, Dental Medicine) and School of Medicine are required to follow their school-specific procedures. For more comprehensive information on academic integrity, including categories of academic dishonesty please refer to the academic judiciary website at http://www.stonybrook.edu/commcms/academic_integrity/index.html

CRITICAL INCIDENT MANAGEMENT:

Stony Brook University expects students to respect the rights, privileges, and property of other people. Faculty are required to report to the Office of Student Conduct and Community Standards any disruptive behavior that interrupts their ability to teach, compromises the safety of the learning environment, or inhibits students' ability to learn. Faculty in the HSC Schools and the School of Medicine are required to follow their school-specific procedures. Further information about most academic matters can be found in the Undergraduate Bulletin, the Undergraduate Class Schedule, and the Faculty-Employee Handbook.

STUDENT PARTICIPATION IN UNIVERSITY-SPONSORED ACTIVITIES

By their participation in campus-related activities such as research conferences, dramatic or musical performances, intercollegiate athletic competitions, or leadership meetings, students make contributions to the University. In recognition of the students' commitment both to their regular academic programs and to related activities, the University makes every effort to accommodate unique situations. Students are responsible for presenting a printed copy of semester obligations to all their professors at the beginning of the semester to alert them to activities that may present conflicts. Instructors are required to make arrangements for students to complete examinations, quizzes, or class assignments early or late if the student's participation in a University-related activity results in the student's absence from the class when such work is due. Some events occur only by invitation during the semester, and instructors should make accommodations for these students.

ATTENDANCE AND EXAMINATIONS

This course does not have a final examination. The academic calendar provides seven days each semester for a Final Examination Period. The last examination of the course, whether comprehensive or covering only a portion of the material, must be given during the Final Examination Period at the time designated for the course. Exceptions may only be granted by the dean of the faculty member's college for compelling academic reasons. Unit exams may only be given during the last week of the semester if a final examination is also given during the Final Examination Period. Instructors are reminded that students who request accommodation for religious reasons are entitled to that accommodation under New York State law. It is the responsibility of the student to plan class schedules to avoid conflicts with Evening Midterm exams and regularly scheduled classes, and to avoid conflicts with Final Exams. Final schedules may be found online at <http://www.stonybrook.edu/commcms/registrar/registration/exams.html>.