# Mechanical Engineering Department Convective Heat Transfer and Heat Exchange | MEC 501 | 3 Credits

Prerequisite: None Class Time: Tu: 4:45 - 7:35 PM Location: CHEMISTRY 126

# Instructor: Wenhai Li

Email: wenhai.li@stonybrook.edu Office Hours: Tu: 12:00 – 3:00 PM via Zoom

# Catalog Course Description:

Differential and integral formulation. Exact and approximate solutions. Topics include parallel and boundary layer flows, similarity solutions, external and internal flows, laminar and turbulent convection, and forced and free convection.

# **Course Learning Objectives:**

- 1 Understand the fundamentals of forced, free, and mixed convection heat transfer.
- 2 Analyze external and internal forced convective flows using differential and integral solutions.
- 3 Analyze external and internal natural convective flows using differential and integral solutions.
- 4 Understand the effects of turbulence to heat convection.

# Textbook:

Adrian Bejan, Convection Heat Transfer, 3<sup>rd</sup> or 4<sup>th</sup> Edition, Wiley

#### Homework:

There will be regularly assigned homework problems, which will be posted on the Blackboard. Students will submit their homework on the Blackboard. Homework needs to be done individually and must be neat and orderly so that your work can be followed clearly.

#### Exams:

Both the midterm and final exams will be open-book. No makeup exam unless arranged prior to the exam. The exam grades will be posted on Blackboard.

# Grading:

Will grade on the curve and the grading scheme is given as follows:

Homework Assignments	20%
Midterm Exam	35%
Final Exam	45%
Total	100%

#### **Tentative Course Outline:**

Торіс	Details
Fundamental Principles (01/25, 02/01)	Continuity, momentum, energy equations and their derivations in different coordinate systems; scaling and non-dimensional analysis. (Bejan, Chapter 1)
Laminar Boundary Layer Flow (02/08, 02/15)	Laminar boundary layer approximations; similarity solution for flow over a flat plate; integral method solutions for flow over a flat plate. (Bejan, Chapter 2)
Laminar Duct Flow (02/22, 03/01, 03/08)	Exact solutions for flow through the circular pipe; fully developed forced convection in pipes with different wall boundary conditions; forced

	convection in thermal entrance region; integral method for internal flows. (Bejan, Chapter 3)
Spring Break (03/15)	No Class
Midterm (03/22)	Materials from fundamental principles, laminar boundary layer flow, and laminar duct flow
External Natural Convection (03/29, 04/05)	Governing equations for natural convection; Boussinesq approximation; similarity solution for laminar flow past a vertical plate with constant wall temperature and heat flux conditions; integral method for natural convection flow past the vertical plate. (Bejan, Chapters 4)
Internal Natural Convection (04/12)	Nature convection in enclosures; mixed convection heat transfer (Bejan, Chapters 5)
Turbulent Convection (04/19, 04/26)	Governing equations for turbulent flow; turbulent flow and heat transfer across flat plate and circular tube; turbulent nature convection heat transfer; empirical correlations for different configurations (Bejan, Chapters 7, 8)
Convection with Change of Phase (05/03)	Flow regimes for boiling (pool boiling, nucleate boiling, film boiling); film condensation. (Bejan, Chapter 10)
May 10 (Tu)	Final Exam (Comprehensive)

# **Copyright Statement**

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# Masks and Social Distancing

For in-person lectures, students are required to wear face masks at all times and maintain social distancing (6 feet between individuals in traditional classrooms, or, in instructional laboratories and similar settings, only a few minutes in closer proximity when necessary to achieve learning objectives). Students who are feeling ill or experiencing symptoms such as sneezing, coughing, or a higher than normal temperature will be excused from class and stay at home. Instructors have the right to ask those who are not complying with these requirements to leave class in the interest of everyone's health and safety. If a student refuses to comply with these requirements, the instructor has the right to cancel a class.

#### **Student Accessibility Support Center Statement**

If you have a physical, psychological, medical, or learning disability that may impact your course work, please contact the Student Accessibility Support Center, 128 ECC Building, (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-people-physical-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 Technology & Management, 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/uaa/academicjudiciary/

#### **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. Until/unless the latest COVID guidance is explicitly amended by SBU, during Spring 2022 "disruptive behavior" will include refusal to wear a mask during classes.