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

Prerequisite: None

Class Time: Tu: 4:00 - 6:50 PM

Location: FREY HALL 216

**Instructor:** Spencer ZimmermanEmail: [spencer.zimmerman@stonybrook.edu](mailto:spencer.zimmerman@stonybrook.edu)

Office Hours: Th: 1:00 – 4:00 PM

**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

(Optional) I.G. Currie, Fundamental Mechanics of Fluids, any edition, McGraw-Hill

(Optional) H. Schlichting, Boundary Layer Theory, any edition

**Homework:**

There will be regularly assigned homework problems, which will be posted on the Blackboard. Students will submit their homework on the Brightspace. 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	30%
Midterm Exam	35%
Final Exam	35%
<b>Total</b>	<b>100%</b>

**Tentative Course Outline:**

Topic	Details
Fundamental Principles (01/23, 01/30)	Continuity, momentum, energy equations and their derivations in different coordinate systems; scaling and non-dimensional analysis. (Bejan, Chapter 1)
Laminar Boundary Layer Flow (02/06, 02/13)	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 (02/20, 02/27, 03/05)	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 (03/12)	No Class
Midterm (03/19)	Materials from fundamental principles, laminar boundary layer flow, and laminar duct flow
External Natural Convection (03/26, 04/02)	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 (04/09)	Nature convection in enclosures; mixed convection heat transfer (Bejan, Chapters 5)
Turbulent Convection (04/16, 04/23)	Governing equations for turbulent flow; turbulent flow and heat transfer across the flat plate and circular tube; turbulent nature convection heat transfer; empirical correlations for different configurations (Bejan, Chapters 7, 8)
Convection with Change of Phase (04/30)	Flow regimes for boiling (pool boiling, nucleate boiling, film boiling); film condensation. (Bejan, Chapter 10)
May 10 (Tu)	Final Exam (Comprehensive)

### 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, Stony Brook Union Suite 107, (631) 632-6748, or at [sasc@stonybrook.edu](mailto: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](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.

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### Understand When You May Drop This Course:

It is the student's responsibility to understand when they need to consider disenrolling from a course. Refer to the Stony Brook Academic Schedule for dates and deadlines for registration:

[http://www.stonybrook.edu/commcms/registrar/calendars/academic\\_calendars](http://www.stonybrook.edu/commcms/registrar/calendars/academic_calendars)

### Incomplete Policy:

Under emergency/special circumstances, students may petition for an incomplete grade. Circumstances must be documented and significant enough to merit an Incomplete. If you need to request an incomplete for this course, contact me for approval as far in advance as possible.

### Course Materials and Copyright Statement:

Course material accessed from Brightspace, Zoom sessions, Homework Assignments, Exams, Lecture videos or a Stony Brook Course website is for the exclusive use of students who are currently enrolled in the course. Content from these systems cannot be reused or distributed without written permission of the instructor and/or the copyright holder. Duplication of materials protected by copyright, without permission of the copyright holder is a violation of the Federal copyright law, as well as a violation of Stony Brook's Academic Integrity.

All federal and state copyright interests are reserved for all original material presented in this course through any medium, including lecture, electronic transmission or print. Individuals may not sell, be paid or receive anything of value for class notes made during this course from any person or entity without the express written permission of (author). In addition to legal sanctions, violation of these copyright prohibitions may result in University disciplinary action.

### Attendance policy:

Students are expected to attend every class, report for examinations and submit major graded coursework as scheduled. If a student is unable to attend lecture(s), report for any exams or complete major graded coursework as scheduled due to extenuating circumstances, the student must contact the instructor as soon as possible. Students may be requested to provide documentation to support their absence and/or may be referred to the Student Support Team for assistance. Students will be provided reasonable accommodations for missed exams, assignments or projects due to significant illness, tragedy or other personal emergencies. In the instance of missed lectures or labs, the student is responsible for reviewing posted slides and recorded lectures. Please note, all students must follow Stony Brook, local, state and Centers for Disease Control and Prevention (CDC) guidelines to reduce the risk of transmission of COVID. For questions or more information click [here](#).

### Make up exams:

The class policy on make-up exams is consistent with university policy on [Student Participation in University Sponsored Events](#), the policy on [Final Exams](#) and the New York State Education Law regarding [Equivalent Opportunity and Religious Absences](#)

### **All make-up exams and other such academic accommodations must be arranged via the Office of the Dean of the students**

**Late Work Policy:** I will generally not accept late work, but if I do, it will be with a considerable penalty, which will be decided on a case-to-case basis.

### Student Learning Resources:

- [Academic and Transfer Advising Services](#): Have questions about choosing the right course? Contact an advisor today. Phone: (631) 632-7082 (option 2); email: [advising@stonybrook.edu](mailto:advising@stonybrook.edu); website: <http://www.stonybrook.edu/commcms/advising/>
- [Amazon @ Stony Brook](#): Order your books before classes begin. Phone: (631) 632-9828; email: [Bookstore.Liaison@stonybrook.edu](mailto:Bookstore.Liaison@stonybrook.edu); website: <http://www.stonybrook.edu/commcms/bookstore/>

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- **Bursar:** For help with billing and payment. Phone: (631) 632-9316; email: [bursar@stonybrook.edu](mailto:bursar@stonybrook.edu); website: <http://www.stonybrook.edu/bursar/>
  - **Career Center** The Career Center's mission is to support the academic mission of Stony Brook University by educating students about the career decision-making process, helping them plan and attain their career goals, and assisting with their smooth transition to the workplace or further education. Phone: (631) 632-6810; email: [sbucareercenter@stonybrook.edu](mailto:sbucareercenter@stonybrook.edu); Website: <http://www.stonybrook.edu/career-center/>
  - **Counseling and Psychological Services:** CAPS staff are available by phone, day or night. <http://studentaffairs.stonybrook.edu/caps/>
  - **Disability Support Services:** Students in need of special accommodations should contact DSS. Phone: (631) 632-6748; email: [dss@stonybrook.edu](mailto:dss@stonybrook.edu); <http://www.stonybrook.edu/commcms/studentaffairs/dss/>
  - **Library:** Access to online databases, electronic journals, eBooks, and more!
    - **Library Instruction Website** - <http://library.stonybrook.edu/workshops-this-week-citation-skills-worldcat-and-endnote-the-hsc/>
    - **SBU Library Research Guides and Tutorials** <http://library.stonybrook.edu/research/research-basics/>
  - **Registrar:** Having a registration issue? Let them know. Phone: (631) 632-6175; email: [registrar\\_office@stonybrook.edu](mailto:registrar_office@stonybrook.edu); <http://www.stonybrook.edu/commcms/registrar/>
  - **Writing Center:** Students are able to schedule face-to-face and online appointments. <https://www.stonybrook.edu/writingcenter/>
  - **Support for Online Learning** <http://www.stonybrook.edu/commcms/onlineed/student.html>
  - **Ombuds Office** The Stony Brook University Ombuds Office provides an alternative channel for confidential, impartial, independent and informal dispute resolution services for the entire University community. We provide a safe place to voice your concerns and explore options for productive conflict management and resolution. The Ombuds Office is a source of confidential advice and information about University policies and procedures and helps individuals and groups address university-related conflicts and concerns. <http://www.stonybrook.edu/ombuds/>