

COURSE INFORMATION

1. **Instructor:** Dr. Igor A. Bolotnov
2153 Burlington Engineering Labs, (518)-542-8939
e-mail (typical response within 12 hours): igor_bolotnov@ncsu.edu
Office hours: Tuesdays: 1pm – 2pm
EOL students OH: Thursdays: 5pm – 6pm (phone or zoom:
<https://ncsu.zoom.us/j/7162243108>)
or by appointment (use e-mail to request a time)

2. **Teaching Assistants:**
 - a. Course assistant:
Max Khvostov (mkhvost@ncsu.edu); (919)-389-8249
Office hours: Friday: 10:00 AM – 12:00 PM NE library (BU 2106)
or by appointment (use e-mail to request a time).
EOL students OH: Monday: 4:00 PM – 5:00 PM (Zoom:
<https://ncsu.zoom.us/j/3578481255?pwd=TXhnUjl0WDdYZldaUFZvMVhhZnNHUT09>)
or by appointment (use e-mail to request a time).

 - b. Lab assistant:
Nicholas Mecham (njimecham@ncsu.edu); (801)-602-3652
Office hours: Wednesday: 1:00pm – 3:00pm NE library (BU 2106)
or by appointment (use e-mail to request a time). In-person office hours are available, but please reach out via e-mail beforehand.

3. **Schedule:**
 - a. Class: Tuesday, Thursday 11:45am – 1:00pm.
Location: 327 111 Lampe Dr.
 - b. Laboratories schedule: arranged by the Lab TA
Locations: see Laboratory section below
 - c. Possible make-up classes: Fridays, Location: TBA (recordings will be available)
 - d. Online **class evaluations** will be available for students to complete during the last 2 weeks of the semester then become unavailable at 8am on the first day of finals.

Students will receive an email message directing them to a website where they can login using their Unity ID and complete evaluations. All evaluations are confidential; instructors **will not know how any one student** responded to any question, and students will not know the ratings for any instructors. Results of the evaluation is revealed to the instructor **after** the grades are assigned.
Evaluation website: <http://go.ncsu.edu/cesurvey>

4. **Prerequisites:**
 - a. MAE 308 “Fluid Mechanics” AND
 - b. Either one of:
 - i. NE 400 “Nuclear Reactor Energy Conversion”
 - ii. MAE 310 “Heat Transfer Fundamentals”

5. Test Schedule

Exam:	<i>In person exams for NE402/502 on-campus</i>	<i>EOL Students Exam Window</i>
Midterm	10/10/2024, 11:40am – 1:00pm, 327 111 Lampe	10/09/2024 – 10/10/2024
Final:	12/05/2024, Noon – 2:30pm, 327 111 Lampe	12/04/2024 – 12/05/2024

<http://www.ncsu.edu/registrar/calendars/examsprg.html>).

6. **Homework:** Homework will be assigned periodically throughout the semester. The last homework assignment may be due during the last week of classes. Homework will be submitted via Moodle. Moodle is used to post lecture notes, homework, and other materials:

<https://moodle-courses2425.wolfware.ncsu.edu/course/view.php?id=2891&bp=s>

Late Assignments: Unless stated otherwise, assignments are due at the beginning of class on the designated due date. Assignments turned in within 24 hours of this time are considered LATE and will be assessed a 25% penalty. Assignments turned in after 24 hours will be marked and returned to the student, but no credit will be assigned. To allow for unforeseen circumstances, students are granted a one-time exemption if an assignment is turned in by 5:00 PM on the designated due date. Exceptions to this policy may be granted for documented medical or family emergencies.

Homework load: Refer to NCSU definition of credit hour and required student effort: <https://oucc.dasa.ncsu.edu/courses/contact-credit-hours/> Specifically, “One credit hour (unit) should involve an input of approximately three hours per week, or the equivalent amount of work for other instructional formats, for the average student (e.g. one hour of scheduled class and two hours of out-of-class preparation)”. For the 4-credit hour course, this translates to about 12 hours effort every week for an *average* student. There are about 7 homework assignments over the 15-week semester, and they will require appropriate effort from a student to succeed in this course.

7. **Attendance:** Required; Active class participation is strongly encouraged. University policy on definition of excused absences: <http://policies.ncsu.edu/regulation/reg-02-20-3> In-class assignments: during the class, simple assignments, requiring about one minute effort about a topic just discussed will be provided. This is used to record the attendance as well as the students’ attentiveness / engagement during the lectures and is a portion of NE 402 student final grade.
8. **Captured Lectures:** This on campus course will be captured and distributed via the Internet and/or electronic media as part of the **Engineering Online** (EOL) program for the distance students. These video recordings *may contain an image of you entering the classroom, asking a question or being a part of the studio class.* Please notify Dr. Linda Krute, Director of EOL, at ldkrute@ncsu.edu if you DO NOT want your image to be included in the lecture presentation. If EOL does not hear from you after the first week of the class, we will assume that you agree with this procedure.

9. Text and Selected References

Recommended texts:

- 1) N. E. Todreas and M. S. Kazimi, *Nuclear Systems I: Thermal Hydraulic Fundamentals*, 2nd edition, 2012. 1034 p., hardcover

2) El-Wakil, *Nuclear Heat Transport*

Other References:

3) N. E. Todreas and M. S. Kazimi, *Nuclear Systems II-Elements of Thermal-Hydraulic Design*

4) Collier, *Convective Boiling and Condensation*

5) Wallis, *One-dimensional Two-Phase Flow*

6) Tong and Weisman, *Thermal Analysis of Pressurized Water Reactors*, 2nd Ed.

7) Lahey and Moody, *The Thermal-Hydraulics of a Boiling Water Nuclear Reactor*

10. **Grading:**

NE-402		NE-502 ABM		NE-502 (including EOL)	
In-class	5 %	In-class	5 %	Mid-Term	20 %
Mid-Term	15 %	Mid-Term	15 %	Homework	25 %
Homework	20 %	Homework	20 %	Project	30 %
Project	15 %	Project	20 %	Final	25 %
Laboratories	25%	Laboratories	20%		
Final	20 %	Final	20 %		

A+ ≥ 96%*

B+ 86 – 88%

C+ 76 – 78%

D+ 65 – 68%

A 92 – 95%

B 82 – 85%

C 72 – 75%

D 61 – 64%

F < 56%

A- 89 – 91%

B- 79 – 81%

C- 69 – 71%

D- 56 – 60%

* Must be top 5% student in the class as well to earn the “A+”.

11. **Artificial Intelligence (AI)** has become an increasingly influential and powerful tool in various fields, including education. In this course, you are welcome to explore and incorporate AI-related concepts and technologies, provided they align with the learning objectives and academic integrity standards of this class. Below are the acceptable uses of AI in this course:

- a. **AI as a Learning Aid:** You are encouraged to leverage AI-based tools and platforms to enhance your learning experience. These tools can provide personalized study resources, interactive simulations, and adaptive learning experiences tailored to your individual progress and needs.
- b. **AI for Research and Data Analysis:** you can utilize AI tools to assist in data processing, pattern recognition, and insights generation. However, it is essential to ensure that you understand the underlying algorithms and interpret the results critically.
- c. **AI Programming and Implementation:** you are encouraged to explore and experiment with various AI techniques to achieve the learning objectives of the programming assignments.
- d. **Ethical Considerations:** In any AI-related work, it is crucial to consider the ethical implications of AI technologies. Ensure that your use of AI aligns with ethical guidelines, respects privacy, avoids bias, and promotes fairness and transparency.
- e. **Collaboration with AI Systems:** You may collaborate with AI systems in projects or assignments, but remember that the primary goal is to enhance your understanding of course materials and concepts. Avoid over reliance on AI to complete tasks without actively engaging with the subject matter.

12. **Academic Integrity:**

- a. University policy on academic integrity: **Code of Student Conduct Policy (POL11.35.1)** (<http://policies.ncsu.edu/policy/pol-11-35-1>)
- b. By signing your name on either test or homework for this course every student implies the following statement: "I have neither given nor received unauthorized aid on this test or assignment"
- c. Absolutely no collaboration is permitted during the tests. All the tests are closed book.
- d. Each homework assignment must be completely your own. Zero grade will be assigned for particular homework for the first offence. Second offense will be reported to the *Office of Student Conduct*

13. As a student, you may experience a range of personal issues that can impede learning, such as strained relationships, increased anxiety, alcohol/drug concerns, feeling down, difficulty concentrating, and/or lack of motivation. These **mental health concerns** or **stressful events** may lead to diminished academic performance and may impact your ability to participate in daily activities. It is very important that you have a support system and that you ask for help when you are struggling. The Counseling Center at NC State offers confidential mental health services for full-time NC State students, including same-day emergency services. Please visit <https://counseling.dasa.ncsu.edu/> to get connected.

14. **Supporting Fellow Students in Distress:** As members of the NC State Wolfpack community, we each share a personal responsibility to express concern for one another and to ensure that this classroom and the campus remains a safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concern or worries you. When this is the case, I would encourage you to report this behavior to the NC State Students of Concern website: <http://studentsofconcern.ncsu.edu/>. Although you can report anonymously, it is preferred that you share your contact information so they can follow-up with you personally.

15. **Students with Disabilities:** Reasonable accommodation will be made for students with verifiable disabilities. To take advantage of available accommodations, students must register with Disability Services for Students at 1900 Student Health Center, Campus Box 7509, 515-7653. For more information on NC State's policy on working with students with disabilities, please see the **Academic Accommodations for Students with Disabilities Regulation (REG02.20.1)**. (<http://policies.ncsu.edu/regulation/reg-02-20-1>)

16. **Electronic devices in class:** Cell phones are to be turned OFF prior to entering the classroom/lab. No exceptions. Use of laptops/other electronic devices during class is permitted only for the purpose of following the posted lecture materials / taking electronic notes.

17. **Other Important Resources**

- **Keep Learning:** [Keep Learning](#)
- **Protect the Pack FAQs:** [Frequently Asked Questions | Protect the Pack](#)
- **NC State Protect the Pack Resources for Students:** [Resources for Students | Protect the Pack](#)
- **Academic Success Center** (tutoring, drop in advising, career and wellness advising): [Academic Success Center](#).

- **NC State Keep Learning, tips for students opting to take courses remotely:**
[Keep Learning Tips for Remote Learning](#)
- **Introduction to Zoom for students:**
<https://youtu.be/5LbPzzPbYEw>
- **Learning with Moodle, a student's guide to using Moodle:**
<https://moodle-projects.wolfware.ncsu.edu/course/view.php?id=226>
- **NC State Libraries [Technology Lending Program](#)**

COURSE TOPICS

1. Single-Phase Flow

- 1.1 Conservation Equations
 - 1.1.1 Mass
 - 1.1.2 Energy
 - 1.1.3 Momentum
 - 1.1.4 Equation of State
- 1.2 Friction and Form Losses
 - 1.2.1 Friction Factors
 - 1.2.2 Bends, Valves and Fittings
 - 1.2.3 Expansions and Contractions
- 1.3 Steady-State Applications
 - 1.3.1 Bernoulli's Equation
 - 1.3.2 Natural Convection Systems
- 1.4 Mixing and Flow Redistribution

2. Two-Phase Flow

- 2.1 Basic Concepts

2.2 Conservation Equations

- 2.2.1 Mass
- 2.2.2 Energy
- 2.2.3 Momentum
- 2.3 Boiling and Non Boiling Heights
- 2.4 Friction and Forms Losses
- 2.5 Acceleration Losses
- 2.6 Critical (Choked) Flow

3. Boiling Heat Transfer and Two-Phase Flow

- 3.1 Fundamental Concepts
- 3.2 Boiling Regimes, Departure from Nucleate Boiling (DNB), Dryout
- 3.3 Flow Boiling Heat Transfer
- 3.4 Critical Heat Flux Correlations
 - 3.4.1 DNB
 - 3.4.2 Dryout

COURSE LABS (NE 402 only)

Lab schedule and workflow:

Groups & scheduling of labs will be assigned based on your availability via this when2meet poll – <https://www.when2meet.com/?25931275-IGRG6> Please plan to fill up the poll by this Friday (8/23/24) to ensure your lab time will not conflict with your other activities. Failure to provide the availability information will result in the assumption that you are available for any time slot.

Each lab consists of:

- a. Before the lab: Students will bring pre-lab homework (answers to questions posted on Moodle along with the lab handout) and submit them by the beginning of the lab overview.
- b. Experimental part performed in groups of 5-6 students under the supervision of the lab TA and/or course instructor.
- c. Data analysis report which is due to the lab TA according to the schedule below.
- d. The report will be graded and returned by the TA according to the schedule below.
- e. Final lab report is due according to the schedule.

- f. The graded final lab report will be returned to students within a month of lab day (or before the final exam for the last lab).

Lab Title	Lab Weeks start on:	Data Analysis Due*	Final Lab Report Due
1. Friction and Form Losses	9/9/2024	9/20/2024**	N/A
2. Natural Circulation (PULSTAR)	9/23/2024***	10/4/2024	10/11/2024
3. Flow Regime Mapping	10/21/2024	11/1/2024	11/8/2024
4. Critical Heat Flux	11/11/2024	11/22/2024	12/3/2024

*These will be returned within 5 days after they have been received

** This report will largely take the format of a data analysis report with an additional conclusion section, and will thus have 33% of the weight of a regular lab grade (not 20%)

***PULSTAR lab will take place during the lecture period

- Each lab from #2 - #4 requires a data analysis report (20% of total lab grade) and a final report (80% of total lab grade).
- Absence of the pre-lab homework at the beginning of the lab overview (or failure to attend the lab overview) will result in a 10% penalty of the particular total lab grade. [These will be graded pass/fail; work of insufficient quality will also result in a 10% penalty]
- Student absence (w/o prior arrangement) from the assigned lab session will result in a 50% penalty for the particular lab total grade.
- Lab Safety: Please wear closed-toed shoes and long pants to each lab in accordance with university policy:

COURSE PROJECTS

- Both NE 402 and 502 components of the class require a project
- The complexity and expectations of the 502 project will be different level from 402, and thus has a stronger influence on the final grade
- The projects will be assigned by 09/05/2024
- The project deliverables will include mid-semester project update (due 10/22/2024) and final project report (due 12/03/2024)