

# ECE 466/566 Spring 2024 Course Syllabus

## Compiler Optimization and Scheduling

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## INSTRUCTOR INFORMATION

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Name	Office Phone	Email	Role	Office Location
James Tuck	[919.513.0923]	jtuck@ncsu.edu	Instructor	EB2 3066
Ahmed Samara		asamara@ncsu.edu	TA	
			TA	

### Office Hours

Name	Time/Day	Location/Link

### Preferred Method of Communication

Please consider the available options and choose the best one. Options:

- For most class-related topics and general questions, post to the class message board. Keep in mind that these posts are viewable by the entire class. However, this also helps guarantee a quick response. You can also post anonymously.
- For a question about a specific assignment, make a comment on the Google Doc. Keep in mind that all posts on Google Docs are public to the class.
- Email the TA or Instructor directly, which is usually the best option for private or personal matters.
- **Call** the Instructor on the phone for **emergencies only**. For example, if you are about to miss an exam due to a traffic accident or due to illness or quarantine, that would merit a phone call. Otherwise, please use the message board or email.

### Response Time

Responses to email and posts will occur within 24 hours. If you do not receive one by that time, please follow up with the instructor by email.

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## COURSE INFORMATION

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**Course Website:** <https://wolfware.ncsu.edu/courses/my-wolfware/>

**Course Credit Hours:** 3

### Meeting Time

Tuesday/Thursday 10:15 am to 11:30 am in person. EB3 2124.

### Prerequisites/Corequisites

In order to take this class, you must have:

- Completed ECE 209 or demonstrated competence in any machine programming language.
- Completed ECE 309/CSC 316 or demonstrated competence with programming data structures and object-oriented programming.
- Programming experience in C/C++.

*Most students find the programming assignments in this course challenging. If you are uncertain about your programming skills, speak with the instructor.*

### General Education Program (GEP) Information

*None.*

### GEP Category Fulfilled

*None.*

### GEP Corequisites

*None.*

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## COURSE OVERVIEW

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### Catalog Description

Provide insight into current compiler designs dealing with present and future generations of high performance processors and embedded systems. Introduce basic concepts in scanning and parsing. Investigate in depth program representation, dataflow analysis, scalar optimization, memory disambiguation, and interprocedural optimizations. Examine hardware/software trade-offs in the design of high performance processors, in particular VLIW versus dynamically scheduled architectures. Investigate back-end code generation techniques related to instruction

selection, instruction scheduling for local, cyclic and global acyclic code, and register allocation and its interactions with scheduling and optimization.

## Goals

This course is designed to give the senior student/introductory graduate student an in-depth understanding of the workings of a performance-oriented code generator. This goal is achieved by the detailed study of real compiler techniques, and via quantitative tradeoff analysis through programming and experimentation. The techniques learned are also useful for hand optimization of code and performance optimization of many software systems.

## Structure

This course is organized in a **flexible flipped format**. Here's what it means to be flexible and flipped:

- **Flipped** - Students are expected to watch previously recorded videos asynchronously on their own time each week that cover the key concepts. Most of the videos have embedded questions that you need to answer to earn "completion" points. The class meets each week and all students are expected to watch the videos before the first class the following week. In other words, Week 1 videos are due before any meeting during W2. All students are expected to watch videos even if you are coming to class meeting. No lecture or in-depth review of content will happen in class.
- **Flexible** - In the flipped model, students come to class as normal and discuss the videos or work through practice problems with the instructor. However, in the flexible flip that we are using this semester, students may choose to participate in person or remotely. You may watch recordings of our class meeting and complete the work on your own, you may watch live and participate synchronously from a remote location, or you can come in person and interact directly with the instructor.

## Class Meetings

Class meetings serve a variety of purposes. Some class meetings will have an organized activity, such as working through tutorials or solving practice problems. These sessions will be recorded and made available synchronously. The other class meetings will be used for office hours in the class room. This is a good opportunity to meet with the instructor to get help with homework or projects.

## Recorded Videos and Embedded Questions

For each week of instruction, there will be at most (and usually less than) 150 minutes of new material. It will be presented through previously recorded videos delivered through Moodle. Some videos have embedded assignments. These need to be completed along with watching the video to receive full credit.

In general, videos are assigned on Tuesday and due before the following Tuesday, except for the first and last week of class that have no prior Tuesday or following Tuesday. Also, some due dates may be adjusted around exams, breaks, holidays, or wellness days and students should pay close attention to deadlines at those times.

Videos with an embedded assignment are deployed through PlayPosit and show up on Moodle as a blue icon with the silhouette of a dog inside. These should be completed during the first week they are assigned in order to keep up with class material. However, you will still earn points for late submissions. Completion of these videos after the last day of class will not be accepted.

### Programming Projects

There will be three in-depth projects. These assignments are designed to deepen your understanding of the material and provide you with a basic set of skills needed to apply for compiler designer jobs in the industry.

Differences between 466 and 566:

- Students registered for ECE 466 will have fewer requirements on each project than students registered for 566.
- 566 students must work on all projects by themselves unless explicitly stated otherwise in the project description.
- 466 students will be encouraged to work in teams of two. You may select your own teammate.

### Exams

To assess your progress during the semester, there will be one paper-based exam. They are mainly intended to test the material since the previous exam, but they may cover any previous material in the course.

All exams are to be completed individually. Evidence of copying or other unauthorized collaboration with any other individuals, whether in the class or outside of it, will be investigated as a potential academic integrity violation. The minimum penalty for cheating on an exam is a grade of -100.

### Homework

The schedule includes four homework assignments this semester. All graded homework is to be done individually and will be submitted electronically to GradeScope. Although you may consult with other students, the instructor, and the TAs on how to approach a problem, you must complete the work on your own.

### Final Exam

There will be a comprehensive final exam, and it will be given according to the university exam schedule.

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## LEARNING OUTCOMES

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ECE 466 and 566 learning outcomes:

1. Describe the fundamental principles of compiler design and the purpose of compiler optimizations.
2. Describe technical approaches for program representation, scalar optimization, dataflow analysis, instruction selection, scheduling, and register allocation.
3. Apply concepts in program representation, scalar optimization, dataflow analysis, scheduling, and register allocation to optimize code by hand.
4. Apply principles of compiler design to implement in code a compiler or sub-component of a compiler.
5. Describe and apply techniques for evaluating the performance of a program before and after optimization.

ECE 566 specific learning outcomes:

6. Evaluate the similarities and differences among common optimizations and transformations.
7. Design, implement and validate compiler optimizations and transformations.

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## COURSE MATERIALS

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### Recommended Textbook and/or Software

- Primary course content will be available in the form of course notes available on the course webpage.
- Engineering a Compiler, by Keith Cooper and Linda Torczon, Morgan Kaufman Publishers, ISBN: 1-55860-698-X.
  - The bookstore is making online versions of the book available for purchase. These will also be acceptable.

### Optional Materials

*If you have supplemental or suggested material, let students know where to access these with costs associated with them, if any.*

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## TECHNOLOGY REQUIREMENTS

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### Hardware

For this class, the minimal requirements are a computer and internet connection that are capable of running a modern web browser, streaming video apps like YouTube, an ssh connection to the VCL, and a text editor. The [minimal compatible system recommended by the university](#) may be adequate. This may require connecting to VCL to implement and test all of the class projects.

If you have a system that meets the following requirements, you should be able to install all of the software on your own system and run it:

- OS: Recent Windows (11 64-bit 21H2 or higher), Mac, or Linux
- Processor less than 4 years old with multiple cores.
- 8 GB or more of memory.
- > 40 GB of available hard drive space.

### Software

*List all technologies that students will need to fully participate in your course. **Include a statement of its purpose. Provide information on how to obtain or access software.** Also, include a link to the accessibility statement and privacy policy.*

We will make use of a variety of software applications:

- [Moodle and Wolfware](#)
  - [Moodle Accessibility Statement](#)
  - [Moodle Privacy Policy](#)
  - [NC State Privacy Policy](#)
- [G Suite](#) (Google Docs, Calendar, Slides, Drive)
  - [Accessibility Statement](#)
  - [Privacy Policy](#)
- [Adobe Reader](#) (for reading PDF files)
  - [Accessibility Statement](#)
  - [Adobe Privacy Policy](#)
- [Zoom](#)
  - [Zoom Accessibility Statement](#)
  - [Zoom Privacy Policy](#)
- [Panopto](#)
  - [Accessibility Features](#)
  - [Privacy Policy](#)
- [PlayPosit](#)
- GradeScope
- Unix command-line tools (cp, mv, find, grep, mkdir, rm, etc)
- ssh
- Text editors
- [LLVM](#)
- [Docker](#)

- [Git, GitHub](#)
- [CLion](#)
- Other supporting libraries that make these tools work.
- [VCL virtual machines.](#)
- GitHub Co-Pilot or ChatGPT

There are links below for installing some of this software. Please check the requirements carefully before proceeding. Note, Project 0 will walk you through the installation of the essential software, so you can wait for that assignment to install this software.

Docker	<a href="#">Windows</a> (Desktop)	<a href="#">Linux</a> (Engine)	<a href="#">Mac</a> (Desktop)
Git	<a href="#">Command Line</a> , <a href="#">GitHub Desktop</a>		
CLion	<a href="#">Install</a>		

## Minimum Computer and Digital Literacy Skills

The ones in bold are particularly relevant to this course, and based on historical observations from past semesters, some students may need to brush up on these skills.

- > Obtain regular access to a reliable internet connection.
- > Proficient typing and word processing skills (MS Word, text editors, Google Docs)
- > Ability to use online communication tools, such as email (create, send, receive, reply, print, send/receive attachments), discussion boards (read, search, post, reply, follow threads), chats, and messengers.
- > Download and upload attachments
- > Knowledge of copy/paste and use of spell check
- > Use computer networks to locate and store files or data
- > Internet skills and ability to perform online research using various search engines and library databases. Visit [Distance Learning Services](#) at NC State Libraries for more information.
- > **Use Linux/Unix command-line tools.**
- > **Connect to remote computer systems using ssh.**
- > **Transfer files to remote computer systems using ssh.**
- > **Run a compiler from the command-line in a terminal window.**
- > **Write a C program and compile it into an executable file.**
- > **Perform debugging (print, gdb) to find a problem in a program.**

## AI Tool Policies

You may use ChatGPT or Github Co-Pilot in this class. On programming assignments, you must document any code produced by AI tools, that documentation must include the prompt you used to produce the code. You must accept full responsibility for finding errors or bugs in the code they provide. We will not allow you to fix problems after the fact introduced by these tools.

You may also use these tools to help with homework assignments. But, you must provide the prompt you used and document any answer provided by these tools in its original form. Also, for each AI derived answer that you include, you must either provide an explanation for why you agree with that answer or you must fix the answer to be correct. If you provide an AI derived answer verbatim with no analysis, you will receive either no points or partial credit only.

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## NETIQUETTE

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Students should be aware that their behavior impacts other people, even online. I hope that we will all strive to develop a positive and supportive environment and will be courteous to fellow students and your instructor. Due to the nature of the online environment, there are some things to remember when taking an online course and engaging with others.

### Tips for Success:

- > **Do:** Follow the same standards of behavior that you subscribe to offline. Keep in mind that all online communication is documented and therefore permanent.
- > **Don't:** Flame others in discussion forums. Flaming is the act of responding in a highly critical, sarcastic, or ridiculing manner – especially if done on a personal level. Remember that these discussions are meant for constructive exchanges and learning!
  
- > **Do:** On Zoom, mute your microphone if it isn't already when you join a room.
- > **Don't:** Unmute and talk over other students who are already speaking.
  
- > **Do:** Remember to read over your posts before selecting "Submit."
- > **Don't:** Use slang, poor grammar, and other informal language in discussion forums or email messages to instructors or classmates.
  
- > **Do:** Post questions about problems you are facing in an assignment. Include Important details such as the system you are running on, (Docker vs VCL vs custom install) and things you've already tried to fix the problem.
- > **Don't:** Post your code to the forum unless it was given to everyone in a lecture or assignment specification. If necessary, make up a similar but different code snippet to illustrate the problem you are having.

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## GRADING

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### Grading Policy

The overall class grade will be a weighted average of the following components:

Assignment	466	566
Programming Projects	33%	33%
Watch Videos & Complete Embedded Assignments	7%	7%

Mid-term Exam	20%	20%
Final Exam	20%	20%
Homeworks	20%	20%
<b>Total</b>	<b>100%</b>	<b>100%</b>

## Grading Scale

This course uses this grading scale:

Low	Letter	High
97 ≤	A+	≤ 100
93 ≤	A	< 97
90 ≤	A-	< 93
87 ≤	B+	< 90
83 ≤	B	< 87
80 ≤	B-	< 83
77 ≤	C+	< 80
73 ≤	C	< 77
70 ≤	C-	< 73
67 ≤	D+	< 70
63 ≤	D	< 67
60 ≤	D-	< 63
0 ≤	F	< 60

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## COURSE SCHEDULE

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The following is a tentative schedule of topics. More details can be found in the [ECE 466/566 Spring 2024 Schedule](#).

Week No.	Date	Topical Outline	Class Meeting	Videos	HW	Project
1	1/9/2024	Welcome; Compiler Design; Front End	Review	W1		
	1/11/2024		Office Hours			P0

2	1/16/2024	Tutorial 1; Front End - Parsing, Scanning	Tutorial 1	W2		
	1/18/2024		Office Hours			x
3	1/23/2024	Intermediate Representations	Tutorial 2	W3	HW1	P1
	1/25/2024		Office Hours			
4	1/30/2024	SSA Form	Problem Session	W4		
	2/1/2024		Office Hours		x	
5	2/6/2024	Optimization	Problem Session	W5	HW2	
	2/8/2024		Office Hours			x
6	2/13/2024	Wellness Day (no class)		--		
	2/15/2024					
7	2/20/2024	Optimization; Loop Optimization	Tutorial 3	W7		P2
	2/22/2024		Office Hours		x	
8	2/27/2024	No new content	Review Session	W8		
	2/29/2024		Midterm Exam			
9	3/5/2024	Control and Interprocedural Optimization	Office Hours	W9	HW3	
	3/7/2024		Office Hours			x
10	3/12/2024	Spring Break		--		
	3/14/2024					
11	3/19/2024	Instruction Selection; Register Allocation	Tutorial 4	W11		
	3/21/2024		Office Hours		x	
12	3/26/2024	Instruction Scheduling	Problem Session	W12	HW4	P3
	3/28/2024		Office Hours			
13	4/2/2024	Loop Scheduling and Modulo Scheduling	Problem Session	W13		
	4/4/2024		Office Hours			
14	4/9/2024	Profiling and Global Scheduling	Problem Session	W14	x	
	4/11/2024		Office Hours			
15	4/16/2024	Advanced Topics	Problem Session	W15		
	4/18/2024		Final Exam			x

			Review			
	4/23/2023	<b>Monday, Last Day of Semester (no class)</b>				
	4/30/2024	<b>Final Exam, 8:30-11:00 am</b>				

Please note: course schedule is subject to change.

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## COURSE POLICIES

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### Late Assignments

Assignments are due at the time designated on the assignment. Electronic submissions are required.

Most assignments will be due at midnight. Since it is unlikely that the TA will begin grading at midnight, written homework assignments and projects **may be submitted late with a penalty**.

For the first 10 hours after the deadline, there is no penalty. But, for each hour after the first 10 hours, you lose 1.5% of your grade. For example, if you submit 12 hours late and earned 85% according to the rubric, your final grade is  $85 - 85 \cdot (1.5 \cdot 2 / 100) = 82.5$ .

Another example: If you wait 24 hours to submit your assignment and make a 100% by the rubric, your final grade will be 79%. This is because  $24 - 10 = 14$  hours penalty.  $14 \cdot 1.5 = 21$ .  $100 - 21 = 79\%$ .

Late submissions without penalty are allowed with an excused absence. Excused absences are determined by the instructor and in compliance with university regulations. In the case of an excused absence, any missed homework is due within 24 hours of your return to school. For the case of a larger project or an extended illness, please discuss with the instructor to determine a suitable due date. (Also, for unanticipated extended absences with multiple missed assignments, schedule an appointment with the instructor upon your return to school to make a plan.)

### Incomplete Grades

Incomplete grades will be assigned when a student cannot complete the course due to unforeseeable conflicts or obstacles. Incomplete grades will normally be made up by completing the work during the following semester, on a schedule agreed upon by student and instructor.

## Attendance and Participation

Attendance is not taken or required at class meetings. However, since class meetings may cover valuable material, students are encouraged to watch the recordings of any meetings they do not attend.

NC State's Attendance Policy: <https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>  
and the Withdrawl Process: <https://studentservices.ncsu.edu/your-classes/withdrawal/process/>

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## UNIVERSITY POLICIES

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### Academic Integrity and Honesty

Students are required to comply with the university policy on academic integrity found in the [Code of Student Conduct](#). Therefore, students are required to uphold the university pledge of honor and exercise honesty in completing any assignment.

Please refer to the [Academic Integrity](#) web page for a detailed explanation of the University's policies on academic integrity and some of the common understandings related to those policies.

Students may be required to disclose personally identifiable information to other students in the course, via electronic tools like email or web-postings, where relevant to the course. Examples include online discussions of class topics and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Students are responsible for reviewing the NC State University PRR's which pertains to their course rights and responsibilities:

- > [Equal Opportunity and Non-Discrimination Policy Statement](#) and [additional references](#)
- > [Code of Student Conduct](#)
- > [Grades and Grade Point Average](#)
- > [Credit-Only Courses](#)
- > [Audits](#)

### Students with Disabilities

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the [Disability Resource Office](#) at Holmes Hall, Suite 304, Campus Box 7509, 919-515-7653 . For more information on NC State's policy on working with students with disabilities, please see the [Academic Accommodations for Students with Disabilities Regulation \(REG02.20.01\)](#)

### Trans-Inclusive Statement

In an effort to affirm and respect the identities of transgender students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than what is listed in the student directory.

## Basic Needs Security

Any student who faces challenges securing their food or housing or has other severe adverse experiences and believes this may affect their performance in the course is encouraged to notify the professor if you are comfortable in doing so. Alternatively, you can contact the Division of Academic and Student Affairs to learn more about the Pack Essentials program <https://dasa.ncsu.edu/pack-essentials/>

## 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 as a whole remains a safe environment for learning. Occasionally, you may come across a fellow classmate whose personal behavior concerns 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.

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## COURSE EVALUATIONS

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ClassEval is the end-of-semester survey for students to evaluate instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers, while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full semester courses and the last week of shorter sessions. Students will receive an email directing them to a website to complete class evaluations. These become unavailable at 8am on the first day of finals.

- > Contact ClassEval Help Desk: [classeval@ncsu.edu](mailto:classeval@ncsu.edu)
- > [ClassEval website](#)
- > [More information about ClassEval](#)

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## AUDIT

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I will allow students to audit the course. The only requirement is that you **watch the videos** and **complete the embedded assignments** associated with some videos. Note, videos with an embedded assignment show up on Moodle with a **blue icon with the silhouette of a dog inside**.

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## SYLLABUS MODIFICATION STATEMENT

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Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order we will cover them in. Dates for assignments represent the earliest possible time they would be due. The pace of the class depends on student mastery and interests. Thus minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.

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## COVID-19

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Due to the COVID-19 pandemic, public health measures continue to be implemented across campus. Students should stay current with these practices and expectations through the [Protect the Pack](https://www.ncsu.edu/coronavirus/) website (<https://www.ncsu.edu/coronavirus/>). The sections below provide expectations and conduct related to COVID-19 issues.

### Health and Participation in Class

We are most concerned about your health and the health of your classmates and instructors/TAs.

- If you test positive for COVID-19, or are told by a healthcare provider that you are presumed positive for the virus, you should not attend any face-to-face (F2F) classes or face-to-face component of a hybrid class. Work with your instructor on any adjustments necessary; also follow other university guidelines, including self-reporting ([Coronavirus Self Reporting](#)): Self-reporting is not only to help provide support to you, but also to assist in contact tracing for containing the spread of the virus.
- If you feel unwell, even if you have not been knowingly exposed to COVID-19, please do not come to a F2F class or activity.
- If you are in quarantine, have been notified that you may have been exposed to COVID-19, or have a personal or family situation related to COVID-19 that prevents you from attending this course in person (or synchronously), please connect with your instructor to make alternative plans, as necessary.
- If you need to make a request for an academic consideration related to COVID-19, such as a discussion about possible options for remote learning, please talk with your instructor.

### Health and Well-Being Resources

These are difficult times, and academic and personal stress are natural results. Everyone is encouraged to [take care of themselves](#) and their peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center ([NCSU Counseling Center](#))
- Student Health Services ([Health Services | Student](#))
- If the personal behavior of a classmate concerns or worries you, either for the classmate's well-being or yours, we encourage you to report this behavior to the NC State CARES team: ([Share a Concern](#)).

- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program ([Pack Essentials](#)).

## Community Standards related to COVID-19

We are all responsible for protecting ourselves and our community. Please see the [community standards](#) and Rule 04.21.01 regarding Personal Safety Requirements Related to COVID-19 [RUL 04.21.01 – Personal Safety Requirements Related to COVID-19 – Policies, Regulations & Rules](#)

## Course Expectations Related to COVID-19

- **Face Coverings:** All members of the NC State academic community are expected to follow all university policies and guidelines, including the [Personal Safety Rule](#) and [community standards](#), for the use of face coverings.
- **Course Attendance:** NC State attendance policies can be found at: [REG 02.20.03 – Attendance Regulations – Policies, Regulations & Rules](#). Please refer to the course's attendance, absence, and deadline policies for additional details. If you are quarantined or otherwise need to miss class because you have been advised that you may have been exposed to COVID-19, you should not be penalized regarding attendance or class participation. However, you will be expected to develop a plan to keep up with your coursework during any such absences. If you become ill with COVID-19, you should follow the steps outlined in the health and participation section above.
- **Technology Requirements:** This course may require particular technologies to complete coursework. Be sure to review the syllabus for these expectations, and see the [syllabus technical requirements](#) for your course. If you need access to additional technological support, please contact the Libraries' Technology Lending Service: ([Technology Lending](#)).

## Course Delivery Changes Related to COVID-19

Please be aware that the situation regarding COVID-19 is frequently changing, and the delivery mode of this course could change accordingly, including from in-person to remote. Regardless of the delivery method, we will strive to provide a high-quality learning experience.

## NO LONGER AVAILABLE - Grading/Scheduling Changing Options Related to COVID-19

Two policies, enhanced S/U Grading Option and Late Drop, put in place at the beginning of the COVID-19 pandemic have been discontinued.

In some cases, an option may be to request an "incomplete" in the course. If you are experiencing difficult or extenuating circumstances, you should discuss possible options with your instructor and your academic advisor.

## Need Help?

If you find yourself in a place where you need help, academically or otherwise, please review these [Step-by-Step Help Topics](#). In addition, the following College of Engineering individuals are very available to assist students with any matter, please reach out to them:

- Dr. Laura Bottomley, Women and Minority Engineering Program, [laurab@ncsu.edu](mailto:laurab@ncsu.edu)
- Ms. Angelitha Daniel, Women and Minority Engineering Program, [aldaniel@ncsu.edu](mailto:aldaniel@ncsu.edu)
- Dr. David Parish, COE Assistant Dean, [dwparish@ncsu.edu](mailto:dwparish@ncsu.edu)
- Dr. Jerome Lavelle, COE Associate Dean, [jplavell@ncsu.edu](mailto:jplavell@ncsu.edu)

## 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](#)

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## COUNSELING SERVICES AND MENTAL HEALTH

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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.