

CSC/ECE 573 Course Syllabus

CSC/ECE 573 – Internet Protocols

Section 002

Fall 2024

3 Credit Hours

Course Description

CSC/ECE 573: Internet Protocols is a course that focuses on the protocols, practices, and design decisions that provide connectivity and performance in the planetary Internet in particular, and any Layer-3 network based on the TCP/IP suite of protocols in particular. It is an important intermediate course of the Masters of Computer Networking degree program jointly offered by *Computer Science* and the *Electrical and Computer Engineering* departments.

The objective of the course is to impart to the student a practical appreciation of the processes that take place inside a Layer-3 forwarding engine, how they are mediated by protocols, and how they give rise to emergent Quality of Service for end-to-end traffic in the Internet. Being able to follow and predict the execution of various relevant algorithms, and coding exemplar versions of them, are integral parts of the course.

Learning Outcomes

Upon satisfactory completion of the course, students will be able to:

- Describe the protocol details of: TCP, IP, ICMP, DNS, ARP, RARP, DHCP, MPLS, VPN, VXLAN, OSPF, BGP;
- Apply knowledge of above protocol details to solve network design problems;
- Describe the internal functional modules of an IP forwarding engine;
- Solve numerical problems of analysis and design related to address lookup, scheduling, buffer management;
- Design and evaluate algorithmic components of Internet appliances.

Course Structure

Classwork (quizzes), homeworks (including any programming assignments, mini-projects), two midterm tests (1 hour each), and a final test (two-and-half hours) will comprise the work products for this course. The midterms, final, all classwork, and most or all of the homework assignments are individual, and each student will submit each work product individually and independently. Some of the homework assignments might be group assignments; groups in all such cases will be assigned by the instructor. Moodle will be used to coordinate the course, and is likely to be used for homework and midterm/final submissions. During most of the semester, lecture hours will be spent largely in problem sessions, based on video lectures that will be assigned for viewing in advance of such problem sessions. The midterm tests will be scheduled during lecture hours.

Course Policies

1. Clean Board Policy:

Other than the specific policies outlined elsewhere in this syllabus, students are also required to honor the policy below. The requirements of enforcing academic integrity and achieving instructional effectiveness poses a dilemma to instructors as well as students. Academic integrity in the classroom translates to professional integrity in the workplace. Moreover, awarding similar grades to students who have maintained academic integrity and to students who have cheated results in conferring equivalent degrees on them, and reduces the value of that degree in the workplace. It is thus to the interest of every student as well as the responsibility of the instructor and TA to see that this is not allowed to happen.

On the other hand, discussion of material presented in class, and homework assignments, can provide good opportunities for learning, and is encouraged among students. The key thing to keep in mind is that collaboration is different from collusion. It is acceptable and indeed highly desirable for students to talk over a problem and work together in solving the problem, but not okay for one student to use the fruits of another's work.

The "Clean Board Policy" may make this more concrete: when you work together with other students, do so at a whiteboard (or the equivalent) on which you collaborate. Once your discussion is over, wipe the board clean. Each student must walk away with the results of the discussion only in his/her head; do not copy anything down. When you are producing your own homework submission, do so alone and individually, reproducing your own understanding, solely from your mind.

2. Grading Curve Policy:

The weighted score to letter grade map used in this course is obtained by using a curve at the end of the semester. The custom map is recalculated every time, taking into account the absolute performance of the majority of the class, the clusters of performance, and the intervals between clusters. The threshold of each letter grade is guaranteed not to rise above that in the standard grade map, which can be found later in this syllabus.

3. 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 Cares website : <https://prevention.dasa.ncsu.edu/nc-state-cares/about/> . Although you can report anonymously, it is preferred that you share your contact information so they can follow-up with you personally. In no sense is this "telling on" or otherwise mis-serving fellow students; rather it is concern for such a student and a desire to obtain appropriate help.

4. Consulting material and fair use:

During midterm and final tests, student may refer to any books or notes they bring with them, or any static information they may have bookmarked on the

web. However, it is absolutely not acceptable (and considered cheating) for a student to consult another person by any means during the test, or to consult a dynamic lookup service (such as websites on which questions may be entered and responses obtained from automated systems).

For the purpose of completing programming assignments, and the term project, it is acceptable for students to search the web and find available codebases that they re-use and build on. In all such cases, use is acceptable ONLY if (a) the codebase is publicly available and has been published or contributed as "open source" code, and (b) the student meticulously documents all such code they use, by maintaining and providing (as part of their work product) information (license) documenting the open source nature of the code, and where they obtained the license (and the code) from.

5. Pandemic related considerations:

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

A. 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 hybrid or face-to-face (F2F) classes and 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.

B. Health and Well-Being Resources

These are difficult times, and academic and personal stress is a natural result. Everyone is encouraged to take care of themselves (<https://counseling.dasa.ncsu.edu/resources/self-help-resources/self-care/>) and their peers. If you need additional support, there are many resources on campus to help you:

- Counseling Center (<https://counseling.dasa.ncsu.edu/>)
- Student Health Services (<https://healthypack.dasa.ncsu.edu/>)

- 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 using the Share a Concern form:

(https://cm.maxient.com/reportingform.php?NCStateUniv&layout_id=2)

- If you or someone you know are experiencing food, housing or financial insecurity, please see the Pack Essentials Program (<https://dasa.ncsu.edu/pack-essentials/>).

C. Community Standards related to COVID-19

We are all responsible for protecting ourselves and our community. Please see the community standards (https://www.ncsu.edu/coronavirus/reactivating-campus/community-standards/?utm_source=ALL+STAFF%2FFACULTY%2FSTUDENTS+-+UCOMM&utm_campaign=0d221175c9-EMAIL_CAMPAIGN_72820_Community_Standards&utm_medium=email&utm_term=0_e7a0fd0c9f-0d221175c9-92460566) and Rule 04.21.01 regarding Personal Safety Requirements Related to COVID-19 (<https://policies.ncsu.edu/rule/rul-04-21-01/>).

D. 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 (<https://policies.ncsu.edu/rule/rul-04-21-01/>) and community standards (https://www.ncsu.edu/coronavirus/reactivating-campus/community-standards/?utm_source=ALL+STAFF%2FFACULTY%2FSTUDENTS+-+UCOMM&utm_campaign=0d221175c9-EMAIL_CAMPAIGN_72820_Community_Standards&utm_medium=email&utm_term=0_e7a0fd0c9f-0d221175c9-92460566), for the use of face coverings. Face coverings are required in instructional spaces. Face coverings should be worn to cover the nose and mouth and be close fitting to the face with minimal gaps on the sides.
- **Course Attendance:** NC State attendance policies can be found at: REG 02.20.03 – Attendance Regulations – Policies, Regulations & Rules (<https://policies.ncsu.edu/regulation/reg-02-20-03-attendance-regulations/>). 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. COVID 19-related absences will be considered excused; documentation need only involve communication with your instructor.
- **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 (<https://go.ncsu.edu/syllabus-tech-requirements>) for your course. If you need access to additional technological support, please contact the Libraries' Technology Lending Service: (<https://www.lib.ncsu.edu/devices>).

E. 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 may need to change accordingly, including from in-person to online. Regardless of the delivery method, we will strive to provide a high-quality learning experience.

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

Two policies, (1) enhanced S/U Grading Option, and (2) Late Course Drops, were put in place at the beginning of the COVID-19 pandemic to ease student stress and promote course completion. Those two policies have been discontinued and thus are no longer available to students.

For situations where relief may be needed, and depending on the details, students should explore the applicability of an "incomplete" grade in the course. If you are experiencing difficult or extenuating circumstances, you should discuss possible options with your instructor and your academic advisor.

G. Need Help?

If you find yourself in a place where you need help, academically or otherwise, please review these Step-by-Step Help Topics: <https://dasa.ncsu.edu/step-by-step-help-topics/> .

H. Other Important Resources

- Keep Learning: <https://dasa.ncsu.edu/students/keep-learning/>
- Protect the Pack FAQs: <https://www.ncsu.edu/coronavirus/frequently-asked-questions/>
- NC State Protect the Pack Resources for Students: <https://www.ncsu.edu/coronavirus/reactivating-campus/resources-for-students/>
- Academic Success Center (tutoring, drop in advising, career and wellness advising): <https://asc.dasa.ncsu.edu/>
- NC State Keep Learning, tips for students opting to take courses remotely: <https://dasa.ncsu.edu/students/keep-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 (<https://www.lib.ncsu.edu/devices>)

Instructors

Dr Rudra Dutta (rdutta) - *Instructor*

Email: rdutta@ncsu.edu

Web Page: <http://dutta.csc.ncsu.edu>

Phone: 919-515-8650

Fax: 919-515-7896

Office Location: Engineering Building III (EB3), Room 2402C

Office Hours: Thursdays, 10:30 AM - 12:00 noon, Zoom (no in-person office hours)

Zoom link (also available from course Moodle locker):

<https://ncsu.zoom.us/j/96237876425?pwd=RS9dPs1k01nJkfwB0hJgOLYNKTXfGe.1>

(These hours and this link is only valid from the first day to the last day of classes in the semester.)

Tristan Mullins (tcmullin) - *Teaching Assistant*

Email: tcmullin@ncsu.edu

Web Page: <http://dutta.csc.ncsu.edu>

Phone: N/A

Fax: N/A

Office Location: TBA

Office Hours: TBA

Course Meetings

Problem Session

Days: T-Th

Time: 4:30pm - 5:45pm

Campus: Centennial

Location: Engineering Building 2 (EB2) - Room 1021

This meeting is required.

Meeting Notes

At this writing, classes are planned to be held in person, in EB2-1021 on the Centennial Campus. This may need to change during the semester, based on circumstances, and students will be informed of such.

Although attendance may not be taken at each meeting, and there is no explicit grading component for attendance, all registered students are expected to attend all scheduled lecture sessions in full (unless specific instructions provided during the semester for any particular lecture session say otherwise). See "Attendance Policy" elsewhere in this syllabus, and the relevant section of "Course Policies" dealing with Course Expectations Related to COVID-19.

The lecture sessions will be largely utilized in active problem solving, based on material made available in advance of these sessions. These materials will largely consist of video lectures. Students are expected to view the lectures, and attempt the problems, before the scheduled meeting time; failing to do so will seriously reduce your learning benefit out of the meeting. A few traditional lectures may be included, as well as midterm tests, in the same timeslot.

It may be possible to provide video recordings of live sessions, to allow students who miss occasional sessions to catch up. However, such recordings are likely to provide far less learning benefit for the student, and are not guaranteed to capture all the activity that went on in respective sessions.

Course Materials

Textbooks

None.

Expenses

None.

Materials

Laptop or desktop computer required in order to access course materials, access remote lab environment, submit work products - Variable cost - free to rent from NCSU Libraries

This material is required.

Requisites and Restrictions

Prerequisites

ECE/CSC 570 or equivalent

Co-requisites

None.

Restrictions

None.

Transportation

This course will not require students to provide their own transportation.

Safety & Risk Assumptions

None.

Grading

Grade Components

Component	Weight	Details
In-class quizzes	5	Each graded quiz counts equally
Homework assignments	35	Each graded homework counts equally
Midterm Test 1	15	
Midterm Test 2	15	
Final Test	30	

Letter Grades

This Course uses a custom curve for letter grading as described earlier in this syllabus (see "Course Policies"). Typically this curve is significantly more lenient than the standard NCSU grademap (provided below for context); that is the cut-off for each given letter grade is fixed to a lower absolute grade than indicated in the standard grademap.

Standard NCSU Letter Grading:

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

Requirements for Credit-Only (S/U) Grading

In order to receive a grade of S, students are required to take all exams and quizzes, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to <http://policies.ncsu.edu/regulation/reg-02-20-15>.

Alternatively, credit-only students may fulfill all requirements that regular students do *except* take the final test; in that case, they must make the equivalent of a B- or better to obtain an S grade.

NOTE: During the pandemic conditions, students were also allowed to pursue the "Enhanced S/U grading option" as described in the "Course Policies" section elsewhere in this syllabus. If such an option is available again this semester, and a student pursues that process, the requirements for an "S" will be governed as laid out by that policy. However, in that case, they need to complete ALL the work products of the course (including the final exam). This is inevitable, since the "Enhanced S/U grading option" allows a student to request conversion to the S/U grading option until well after the completion of the semester.

NOTE: At this time, the "Enhanced S/U grading option" is not allowed, and is not projected to become allowed. The above note addresses the contingency that an unforeseen policy change allows a return of that option.

Requirements for Auditors (AU)

Information about and requirements for auditing a course can be found at <http://policies.ncsu.edu/regulation/reg-02-20-04>.

Audit students must fulfill all requirements that regular students do except take the final test, and must make the equivalent of a B- or better to obtain an AU grade.

Policies on Incomplete Grades

If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. The university policy on incomplete grades is located at <http://policies.ncsu.edu/regulation/reg-02-50-3>.

Late Assignments

Unless specifically announced otherwise for a specific work product, late submissions or attempted submissions for any work product will not be graded, and a score of zero for that work product will count toward the semester total for a student. For the purpose of being counted as a valid submission, the work product must have been submitted in accordance with instructions provided for that work product.

Attendance Policy

For complete attendance and excused absence policies, please see <http://policies.ncsu.edu/regulation/reg-02-20-03>

Attendance Policy

Students are expected to attend in full every scheduled lecture. Attendance does not count for grades, but it ensures engagement with the course, which has historically been demonstrated to improve comprehension of material and performance in work products. Requests for re-explanation of material covered in class may not be possible to honor if the students making the request have not been attending the lectures in which the material was originally explained. Grades for quizzes administered in-class can only be earned by students who are in attendance when the quiz is administered. Grades for quizzes missed in class will not be possible to make up in any way (except as allowed by the Excused Absence policy as listed below).

Grades for Midterm and Final Tests, which will be administered in-class, can only be earned by students who are in attendance when the Test is administered. Grades for missed Tests will not be possible to make up in any way (except as allowed by the Excused Absence policy as listed below).

Absences Policy

Absences will be dealt with in accordance with NCSU Regulation 02.20.03 (<https://policies.ncsu.edu/regulation/reg-02-20-03/>). Excuses other than those listed in the above-cited regulation may on some occasions be accepted on compassionate grounds, but are not guaranteed to be; in any case they will always require some attempts at prior notification and/or documentation and substantiation by appropriate proof and records.

Makeup Work Policy

Since later material aggressively builds on earlier material in this class, in general make-up work will not be possible to assign in this course. Grading points lost to a student due to an approved or allowed absence will in general be made up, when appropriate, by transferring the corresponding grading weightage to some other work product.

Additional Excuses Policy

None.

Academic Integrity

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at <http://policies.ncsu.edu/policy/pol-11-35-01>

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct found at <http://policies.ncsu.edu/policy/pol-11-35-01> . Violations of academic integrity will be handled in accordance with the Student Discipline Procedures (NCSU REG 11.35.02).

In addition, please see the "Clean Board Policy" specified elsewhere on this syllabus.

Honor Pledge

Your electronic or physical signature on any test or assignment indicates "I have neither given nor received unauthorized aid on this test or assignment."

Digital Course Components

Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as 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.

Digital Course Components: Moodle and Panopto for course material presentation and exams, as well as Moodle for discussion forums.

Accommodations for 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) (<https://policies.ncsu.edu/regulation/reg-02-20-01/>).

Non-Discrimination Policy

NC State provides equal opportunity and affirmative action efforts, and prohibits all forms of unlawful discrimination, harassment, and retaliation ("Prohibited Conduct") that are based upon a person's race, color, religion, sex (including pregnancy), national origin, age (40 or older), disability, gender identity, genetic

information, sexual orientation, or veteran status (individually and collectively, "Protected Status"). Additional information as to each Protected Status is included in NCSU REG 04.25.02 (Discrimination, Harassment and Retaliation Complaint Procedure). NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at <http://policies.ncsu.edu/policy/pol-04-25-05> or <https://oied.ncsu.edu/divweb/>. Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

Course Schedule

NOTE: The course schedule is subject to change.

Problem session TH 4:30pm - 5:45pm — Intro, Recap, Protocols — 08/19/2024 - 09/26/2024

Course Introduction
Development and Current Structure of Internet
Ethernet, TCP, IP, DNS, ARP, RARP

Midterm 1.

Problem session TH 4:30pm - 5:45pm — Network, Performance — 09/27/2024 - 11/14/2024

Network performance and QoS
Address lookup, buffer management, scheduling
Label switching
Routing - OSPF, BGP

Midterm 2.

Problem session TH 4:30pm - 5:35pm — Application, Emergent, Outstanding Work — 11/15/2024 - 12/3/2024

Software Defined Networking
Any outstanding material

Final Exam:
December 5th, 3:30 - 6:00 PM.