

Master of Science in Technology, Cybersecurity and Policy (TCP)

Student Handbook

AY 2019-2020

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Technology, Cybersecurity
and Policy Program

UNIVERSITY OF COLORADO **BOULDER**

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Foreword

The Technology, Cybersecurity and Policy (TCP) Program is an interdisciplinary program offering primarily graduate degrees designed to train future leaders in the areas of network engineering, wireless networks and spectrum management, cybersecurity, policy and strategy. The current TCP program is a continuation of the Interdisciplinary Telecom Program (ITP) that was established in 1971. The program was updated in 2019 to add cybersecurity as a core component as well as better reflect changes in network technologies. The program continues to emphasize the key roles of policy and strategy along with cutting edge technology in network engineering, wireless networks, and cybersecurity.

The TCP program accepts students from a broad range of fields and is formally part of the College of Engineering. Founded in 1893, the College of Engineering and Applied Science at the University of Colorado Boulder is the second largest of seven schools and colleges at one of the nation's top public research institutions. As Colorado's flagship university, CU Boulder has selective admissions standards and a comprehensive array of undergraduate and graduate programs.

Honor Code

The University of Colorado Boulder is dedicated to maintaining the highest standards of intellectual honesty. Commitment to these standards is the responsibility of every student, faculty and staff member. Here is a link to the [Honor Code](#) which was designed to uphold CU Boulder's standards of academic integrity and intellectual honesty. All students of the University of Colorado Boulder are subject to the Honor Code for academic matters.

Honor Code Pledge

On my honor, as a University of Colorado Boulder student, I have neither given nor received unauthorized assistance.

Colorado Creed

The [Colorado Creed](#) is a social responsibility code. It is a way of life and a reminder act with honor, integrity, and respect.

Colorado Creed

As a member of the Boulder community and the University of Colorado Boulder, I agree to:

- Act with honor, integrity and accountability in my interactions with students, faculty, staff, and neighbors.
- Respect the rights of others and accept our differences.
- Contribute to the greater good of this community.

I will strive to uphold these principles in all aspects of my collegiate experience and beyond.

MS in TCP Objectives and Purpose

The MS in TCP is an interdisciplinary degree that combines deep technical expertise with in-depth policy and strategy. This program is designed for someone who is passionate about how technology is actually deployed and used. On the technical side, students learn about critical topics in cybersecurity, network engineering, and wireless networking. Equally important is that students gain a deep understanding of the policy and strategy issues facing network and cybersecurity professionals. Today's industry leaders must know the technical details as well as the corresponding policy and strategy challenges. Our graduates go on to lead teams at Fortune 500 companies, found innovative startups, develop policies in spectrum management and cybersecurity, develop international standards, and lead in government agencies.

MS in TCP Curriculum

Course Requirements	Credit Hours
TCP Seminar Courses - 1 one credit pass/fail course taken in the first and second semesters	2
1 Fundamentals Course - Technical background to prepare students for advanced courses	3
4 Core Courses - 1 course in each TCP Core area	
▸ Core Course in <i>Networking</i>	3
▸ Core Course in <i>Cybersecurity</i>	3
▸ Core Course in <i>Policy</i>	3
▸ Core Course in <i>Strategy</i>	3
3 Advanced Elective Courses - Electives in any of the above Core areas that are selected by the student	9
2 Graduate Capstone or MS Thesis Courses - Two semester substantial project or thesis	6
Total Required Hours	32

TCP Seminar

The TCP seminar is a one credit pass/fail course intended to introduce students to a variety of topics in technology, cybersecurity and policy. The weekly seminar brings in experts from around the world. This helps students gain a better understanding of potential topics and opportunities. The seminar is taken in the first year, before students are asked to select capstone or thesis topics. Students enroll in the one credit seminar for their first semester and again enroll for one credit in their second semester for a total of 2 pass/fail credits. After completing two semesters of the seminar, all students are encouraged to attend the weekly seminar talks in order to stay current in the field and hear directly from experts in technology, cybersecurity, and policy.

Fundamental Courses

A Fundamentals course is designed to provide needed background for more advanced technical topics. To select a Fundamentals course, students are encouraged to check the prerequisites for their desired Core and Advanced Elective courses. If a student lacks the background needed for a Core or Advanced Elective, the Fundamentals courses provide a way to obtain that background. Students with an exceptional background may not be required to take a Fundamentals course and can substitute an Advanced Elective instead. Currently two TCP Fundamentals courses are offered and a full list of courses is found on the TCP Course Offerings page.

Core Courses

The TCP program has four Core areas: Networking, Cybersecurity, Policy, and Strategy. These four areas form the cornerstones of the TCP degree and students are required to complete one Core Course in each of those four areas. The Core areas cover the skills needed to become a leader in Technology, Cybersecurity and Policy. This ensure graduates have the technical, policy, and strategy skills to work in industry and also ensures graduates have the skills needed to advance to senior leadership levels. Full-time students are expected to complete the Core Course requirement by the end of the first two semesters. The resulting four Core Courses cover 12 credit hours.

1. Networking Core Courses - TCP students are required to take one three-credit Networking Core Course and must choose one course from the approved list found on the TCP Course Offerings page. These courses cover key topics in Networking Engineering, Wireless Networks, Network Management, and Internet Routing. There are currently four Networking Core Courses. Students may also take approved alternates from the CU Department of Computer Science and CU Department of Electrical Engineering. A full list of TCP courses and approved alternates from the Department of Computer Science and Department of Electrical Engineering can be found on the TCP Course Offerings page.

2. Cybersecurity Core Courses - TCP students are required to take one three-credit Cybersecurity Core Course and must choose one course from the approved list found on the TCP Course Offerings page. These courses introduce students to the key concepts in the design and use of cybersecurity techniques. The TCP program currently offers one Cybersecurity Core Course or students may also take one of several approved courses offered by the CU Department of Computer Science. A full list of TCP courses and approved alternates from the Department of Computer Science can be found on the TCP Course Offerings page.

3. Policy Core Course - TCP students are required to take one three-credit Policy Core Course and must choose one course from the approved list found on the TCP Course Offerings page. These courses introduce students to the key concepts in technology policy as well as its use in both industry and government. The TCP program currently offers one Policy Core Course or students may also take one of several approved courses offered by the CU Law School or the CU Department of Political Science. A full list of TCP courses and approved alternates from the Law School and Department of Political Science can be found on the TCP Course Offerings page.

4. Strategy Core Course - TCP students are required to take one three-credit Strategy Core Course and must choose one course from the approved list found on the TCP Course Offerings page. These courses introduce students to the key concepts in technology strategy and management. The TCP program offers one Core Strategy Course or students may also take one of several approved courses offered by the CU Engineering Management Program or the CU Leeds College of Business. A full list of TCP courses and approved alternates from Engineering Management and Business can be found on the TCP Course Offerings page.

Advanced Elective Courses

The TCP program requires three elective courses that are selected by the student. Students select any combination of courses from the approved list found on the TCP Course Offerings page. The Advanced Elective Courses allow a student to tailor the degree to their interests. For example, a student interested primarily in Network Engineering can select three approved network engineering electives, a different student interested primarily in cybersecurity can select three approved cybersecurity electives, and yet another student interested in mix of the topics could choose one approved cybersecurity course, one approved policy course, and complement this by an approved graduate course from Computer Science, the Law School, Business School, Engineering Management Program, Political Science, or other departments.

All Advanced Elective Courses are three-credit graduate courses and by selecting three the student completes 9 credit hours toward the degree.

Capstone, Thesis, or Portfolio

The culmination of the degree is a two course sequence that is either a capstone project or thesis. In some cases, students can propose to complete the degree with an approved Portfolio.

Students electing to take the Capstone sequence will work in teams to complete an advance project that includes aspects of the four Core areas. Capstone projects are often done in conjunction with industry partners. Topics are selected based on the combined interests of the students, the faculty, and external partners such as industry and government.

Students electing to take the Thesis sequence will work with a faculty advisor to complete a thesis on a topic of mutual interest that includes aspects of the four Core areas. A thesis requires the student find a faculty advisor and this is typically accomplished by doing well in courses taught by the potential faculty advisor. In addition to thesis advisor, the student and faculty advisor choose two additional faculty members to form a three-member thesis examining committee. The members of this committee must be approved by the TCP Program and by the Graduate School. The student works primarily with the thesis advisor and provides both a written document and arranges a presentation (thesis defense/thesis exam) before the thesis examining committee. Examination Report Forms must be filed with the TCP Program at least two weeks

prior to the date of your defence (exam). Students must be registered during the semester in which they defend their thesis. Additional information, rules, dates and deadlines, and thesis submission requirements can be found on the [Graduate School](#) website. If a student is unable to find a faculty advisor, the student should pursue a capstone project.

For full-time students, the decision whether to pursue a capstone or thesis must be made prior to the start of the second year. In the third semester, a student will either be enrolled in the Capstone course sequence or enrolled in the Thesis course sequence. Since both the Capstone and Thesis options are two course sequences, switching from Capstone to Thesis (or vice versa) is rare and will require an additional semester.

Students electing to take the Portfolio Option must first obtain approval from the TCP

Program. Under the Portfolio Option, students complete the 3 Advanced Electives required of all students and then substitute two additional Advanced Electives in place of Capstone or Thesis Courses. Approval of a Portfolio is not automatic and requires the student submit a two page write-up showing how the collection of the 5 Advanced Electives courses form a coherent collection that meet the student's long term career objectives while also providing sufficient breadth and depth to warrant a CU Masters Degree. The two-page write-up must be submitted and approved at least two semesters prior to graduation. In other words, full-time students would submit Portfolio proposals before the end of their second semester and the Portfolio would either be approved or denied prior to the third semesters. Most students will complete either the Capstone or Thesis.

MS in TCP Timeline

All students are required to complete the degree requirements within five years from the date of commencing coursework.

Full-time students typically complete the degree in two years. In order to graduate in two years,

- Students are required to complete the Seminar in their first two semesters.
- Students are encouraged to complete the Core Courses in the first two semesters and must complete the Core Courses by the end of the third semester.
- Students take either the Capstone Course Sequence or the Thesis Course Sequence in the third and fourth semesters.

Students can pursue the degree part time and can take up to five years to complete the degree. At the five year pace, a student could take as few as one course in each Fall and Spring semester. Students with graduation paths longer than 2 years must take the seminar in the first two semesters and are encouraged to complete the Core Courses before enrolling in Advanced Electives.

Academic Standards

Minimum Grades and GPA Requirements:

For any TCP graduate degree, a course grade below B- is unsatisfactory and cannot be counted toward fulfilling any requirements for the degree.

A master's degree student is required to maintain at least a B (3.00) average in all work attempted while enrolled in the Graduate School. Any student, who fails to maintain a 3.00 grade point average or to make adequate progress toward completing a degree, as assessed by the student's academic/research advisor, will be subject to suspension or dismissal from the Graduate School upon consultation with the major department. The final decision on suspension or dismissal will be made by the Dean of the Graduate School. See the [Graduate School Rules](#) for additional information.

Incomplete (I) Grades

An incomplete (I) grade is given only when students, for documented reasons beyond their control, have been unable to complete course requirements in the semester enrolled. A substantial amount of work must have been satisfactorily completed before approval of such a grade is given. The final grade (earned by completing the course requirements or by retaking the course) does not result in deletion of the (I) from the transcript. A second entry is posted on the transcript to show the final grade for the course. At the end of one year, (I) grades for courses that are not completed or repeated are regarded as (F) and are shown as such on the student's transcript. Courses with grades of (I) are not included in computation of grade point averages until a final letter grade has been awarded in that course.

Dropping a Course

TCP follows the university guidelines for dropping courses. See the university rules for how a dropped course will impact transcripts and finances.

Graduation Checklist

The following [Graduate School forms](#) must be submitted to the TCP Program for approval.

IMPORTANT: Check the [Graduate School deadlines](#) prior to the start of the semester.

MS Coursework (Capstone or Portfolio option)

- **Apply to Graduate.** Students must apply through myCUinfo.colorado.edu to graduate. This notifies the Graduate School and your department that you intend to graduate. If you do not complete the requirements for graduation, you must log back in and re-apply to graduate for the new graduation date. *You must apply to graduate online whether or not you plan to attend the ceremony.*
- **Candidacy Application for Advanced Degree**

MS Thesis Option

- **Apply to Graduate.** Students must apply through myCUinfo.colorado.edu to graduate. This notifies the Graduate School and your department that you intend to graduate. If you do not complete the requirements for graduation, you must log back in and re-apply to graduate for the new graduation date. *You must apply to graduate online whether or not you plan to attend the ceremony.*

- **Candidacy Application for Advanced Degree**
- **Master's Examination Report**
- **Final Grade Card**
- **Signature Page** – original page with original signatures
- **Final Copy of [Thesis](#)** must be submitted online

Contact persons

TBD (first point of contact)

Graduate Advisor

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Appendix A –Sample Curriculum

Two Year Plan For a TCP MS Student:

1st Semester	2nd Semester	3rd Semester	4th Semester
TCP Seminar (1 credit pass/fail)	TCP Seminar (1 credit pass/fail)	Capstone or Thesis (3 credits)	Capstone or Thesis (3 credits)
Fundamentals Course	Networking Core Course	Advanced Elective 2	Advanced Elective 3
Cybersecurity Core Course	Strategy Core Course		
Policy Core Course	Advanced Elective 1		

All students are required to take the TCP Seminar and Capstone/Thesis. There are multiple choices for the Fundamentals, Core, and Advanced Elective Courses. There are more than 10,000 possible course plans that lead to a degree: Fundamental Courses (at least two options), the Core courses (at least ten options), and the Advanced Electives (over 40 options), students are encouraged to work with the TCP Graduate Advisor and the TCP faculty to select the courses that best fit their interests and objectives. It is also common for student interests to change based on information learned in the TCP seminar and the Core Courses. A few examples are listed below and are intended only to illustrate some of the over 10,000 possible options:

Cybersecurity:

A student interested primarily in cybersecurity might take the following elective choices.

Fundamentals Course: CYBR 5016 Fundamentals of Network Systems

Cybersecurity Core Course: CYBR 5300 Introduction to CyberSecurity.

Policy Core Course: CYBR 5400 Principles of Internet Policy

Networking Core Course: CYBR 5170 IP Routing Protocols and Policies

Strategy Core Course: CYBR 5500 Entrepreneurship: Commercial Strategy and Operations

Advanced Elective 1: CYBR 6330 Digital Forensics

Advanced Elective 2: CYBR 6350 Penetration and Security Testing

Advanced Elective 3: CYBR 6340 Immersive Cyber Defense

Wireless Networks:

A student interested primarily in wireless networks might take the following elective choices.

Fundamentals Course: CYBR 5016 Fundamentals of Network Systems

Cybersecurity Core Course: CYBR 5300 Introduction to CyberSecurity.

Policy Core Course: CYBR 5400 Principles of Internet Policy

Networking Core Course: CYBR 5200 Introduction to Wireless Systems

Strategy Core Course: CYBR 5500 Entrepreneurship: Commercial Strategy and Operations

Advanced Elective 1: CYBR 6210 Wireless and Cellular Systems

Advanced Elective 2: CYBR 6230 Wireless Systems Lab

Advanced Elective 3: CYBR 6220 Wireless Local Area Networks

Software-Defined Networks:

A student interested primarily in software-defined networks might take the following elective choices.

Fundamentals Course: CYBR 5013 Fundamentals of Systems Administration

Cybersecurity Core Course: CYBR 5300 Introduction to CyberSecurity.

Policy Core Course: CYBR 5400 Principles of Internet Policy

Networking Core Course: CYBR 5150 Network Management and Automation

Strategy Core Course: CYBR 5500 Entrepreneurship: Commercial Strategy and Operations

Advanced Elective 1: CYBR 6150 Software-Defined Networking (SDN)

Advanced Elective 2: CYBR 6151 SDN Virtualization and Orchestration

Advanced Elective 3: CYBR 5160 Introduction to Enterprise Networks

Network Engineering:

A student interested primarily in network engineering might take the following elective choices.

Fundamentals Course: CYBR 5013 Fundamentals of Systems Administration

Cybersecurity Core Course: CYBR 5300 Introduction to CyberSecurity.

Policy Core Course: CYBR 5400 Principles of Internet Policy

Networking Core Course: CYBR 5160 Introduction to Enterprise Networks

Strategy Core Course: CYBR 5500 Entrepreneurship: Commercial Strategy and Operations

Advanced Elective 1: CYBR 6160 Datacenter Networks

Advanced Elective 2: CYBR 6161 Internet Service Provider Networks

Advanced Elective 3: CYBR 5150 Network Management and Automation

Policy:

A student interested primarily in policy might take the following elective choices.

Fundamentals Course: CYBR 5013 Fundamentals of Systems Administration

Cybersecurity Core Course: CYBR 5300 Introduction to CyberSecurity

Policy Core Course: CYBR 5400 Principles of Internet Policy

Networking Core Course: CYBR 5150 Network Management and Automation

Strategy Core Course: CYBR 5500 Entrepreneurship: Commercial Strategy and Operations

Advanced Elective 1: CYBR 5480 Future of Video: Technology, Policy, and Economics

Advanced Elective 3: CYBR 5420 Spectrum Management and Policy

Advanced Elective 2: CYBR 6420 Principles of Cyber Policy

TCP General:

A student interested a broad mix might take the following elective choices.

Fundamentals Course: CYBR 5013 Fundamentals of Systems Administration

Cybersecurity Core Course: CYBR 5300 Introduction to CyberSecurity.

Policy Core Course: CYBR 5400 Principles of Internet Policy

Networking Core Course: CYBR 5150 Network Management and Automation

Strategy Core Course: CYBR 5500 Entrepreneurship: Commercial Strategy and Operations

Advanced Elective 1: CYBR 6150 Software-Defined Networking (SDN)

Advanced Elective 2: CYBR 6330 Digital Forensics

Advanced Elective 3: EMEN 5030 Fundamentals of Project Management