

# CS 4316/5313: Computer Networks

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**Instructor:** Dr. Deepak K. Tosh

**Class Hrs.:** TR, 10:30–11:50AM

**Semester:** SPRING 2024

**Office Hrs.:** TR, 1–2 PM/Appt.

**Email:** dktosh@utep.edu

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**Classroom:** BUSN 331

## A. Course Description

This course offers in-depth concepts of computer networks and with technical foundations of the Internet. Topics to cover include overview of network models, architectures, applications, network programming interfaces (e.g. sockets), protocols and algorithms for routing and transport, congestion control, addressing, local area networks, medium access control, and network security. This course will cover various networking concepts as well as protocols and discuss on how they cohesively work together to provide unique Internet services, with emphasizing on

1. Application, transport network, and link layers
2. Layering benefits through top-down approach in TCP/IP and OSI stack
3. Emergence of software-defined networking and its performance impacts
4. Security of various protocols on TCP/IP stack

## B. Course Objective

The objective of this course is to provide deeper understanding of the generic principles, components, design, and security of modern computer networks with a focus to learn the working mechanism of important protocols and enable secure communication in untrusted Internet.

## C. Course Outline (TENTATIVE)

1. Course Overview and Intro (1 Week)
  - a. What is the Internet?
  - b. Performance, Protocol Layering
  - c. Protocol Layering
  - d. Network Security Basics
2. Application Layer (2 Weeks)
  - a. Principles of Network Applications
  - b. The World Wide Web, HTTP(S), and Email
  - c. Email, DNS
  - d. DNS attacks, DNSSEC
3. Transport Layer (3 Weeks)
  - a. Principles of Transport, UDP
  - b. Reliable Data Transfer
  - c. TCP and Congestion
  - d. Transport layer attacks
  - e. Transport layer security (TLS)
4. Network Layer: Data Plane (2 Weeks)
  - a. Overview and Addressing
  - b. Dissecting a Router
  - c. Internet Protocol (IP)

- d. Generalized forwarding and SDN
- e. IP and ICMP attacks
- 5. Network Layer: Control Plane (2 Weeks)
  - a. Routing Algorithms
  - b. Intra-AS routing
  - c. BGP and its security
  - d. SDN control plane
- 6. Link Layer and LANs (2 Weeks)
  - a. Intro to Link Layer, Multiple Access Links
  - b. Error detection and correction
  - c. ARP
  - d. LANs, Virtual networks/links
  - e. MAC layer attacks (ARP Poisoning, MITM)

**Note:** We may cover advanced topics that are beyond the textbook. In that case, the instructor will upload the electronic copies of the handouts/weblinks in the Blackboard. Therefore, you will need regular access to a computer, stable/consistent Internet, Blackboard, and your UTEP email account for succeeding in this class.

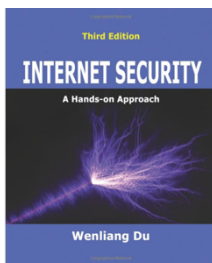
## D. Prerequisite

C or better in CS 3432: Computer Organization

## E. Required Materials/Books



“Computer Networking: A Top-Down Approach” by James F. Kurose and Keith W. Ross. (8<sup>th</sup> Edition)



“Internet Security: A Hands-on Approach” by Wenliang Du (3<sup>rd</sup> Edition)

**Other Reference Book** – Computer Networks: A systems Approach by Larry Peterson and Bruce Davie, Sixth Edition. <https://book.systemsapproach.org/>

**Required Prior Knowledge** – (1) You must know how to write programs in C and Python, if not, learn now. These two programming languages will be heavily used in the assignments; (2) You must be familiar to use VirtualBox or VMWare to configure and network among multiple VMs. Please visit the following links to learn more about them.

- 1) Learn C - <https://www.learn-c.org/>

- 2) Socket Programming - <https://beej.us/guide/bgnet/>
- 3) Learn Python - <https://www.learnpython.org/>
- 4) VirtualBox - <https://www.virtualbox.org/manual/>

## F. Course Assignments and Grading Policies

Your semester grade will be based on a weighted combination of homework assignments, quizzes, participation, and exam. The approximate percentages for each category are given in the following and the final grade will be calculated using weighted average of these items.

### Tentative Grade Distribution

Scoring Components	CS 5313	CS 4316
Quizzes and Participation (QP)	15%	20%
Homework and Programming Assignments (A)	30%	40%
Exams (E)	35%	40%
Project (P)	20%	<Optional>

Total Score	90-100	80-89	70-79	60-69	59 and Below
Grade	A	B	C	D	F

**\*\* Students are required to agree to the UTEP College of Engineering's [Honor Code](#).**

**Important Note:** You will have one week to appeal for your grades after the graded assignments and tests are returned. So, please keep this in mind if you think that there is a problem/issue with the grading of your work.

#### a. Homework and Programming Assignments

There will be tentatively 4 homework assignments to let the students practice theoretical notions of computer networks. To build competency on network programming and security, there will be 3-4 programming assignments. Through these assignments, students will develop concrete understanding on various protocols at each layer of TCP/IP stack along with their security issues.

**Note-1:** Students/Teams may be asked to demonstrate their assignments and answer additional follow up questions, whenever the instructor needs to verify the originality of their works. It is student's responsibility to come prepared while demonstrating his/her work. If the student could not answer, the 50% of the respective question's score will be deducted.

**Note-2:** Uniqueness and plagiarism will be strictly checked in the submitted codes, documents, reports etc. If the instructor finds plagiarized submission, the student will be reported to dean's office and score for that assignment will be given as zero.

**Note-3:** Any external materials referred to solve the assignment tasks must be CITED as references in the reports.

## b. Quizzes, and Participation

There will be in-class quizzes before start of the class. Students must attend all lectures and read the assigned topics before coming to class. Quizzes cannot be retaken unless the student has a very special reason (with proof).

## c. Exams

There will be two midterms and a final exam. The final exam will be conducted on the day of UTEP's allotted day, which is **9<sup>th</sup> May 2024, 10am-12pm**. Each midterm will have estimated duration of 80 minutes. The format of the exams will be further discussed in the class and announced later. If special accommodation is needed, you need to take proctoring appointment with CASS office beforehand.

## d. Project

The students who are registered for 5313 are mandated to work on a group project (team of 3 maximum). Students need to finalize their project idea and team by 2<sup>nd</sup> week of class. The project idea must be approved by the instructor before the teams can start working on them. The following activities (with percentages allocated and deadline) are required to be done by each team.

- i. Project ideation and teaming (1%, week-2)
- ii. Submit Project Synopsis – with Goals, objectives, milestones, and timeline (2%, week-3)
- iii. 4 Meetings w/ instructor to discuss/demonstrate progress (2%, anytime between week-4 to 2<sup>nd</sup> last week)
- iv. Final Presentation (5%, 2<sup>nd</sup> last week)
- v. Final Report and Peer Evaluation (10%, 2<sup>nd</sup> last week)

\*\* The undergraduate students are strongly encouraged to team up for project. This will give them the chance to recover 10% points from one of the midterm exams.

### **Late Submission Policy:**

- **No extension** on the **assignments** submission due dates will be given unless there are special medical emergencies.
- Late submissions will be penalized with 10% deduction per day up to a maximum of 5 days. Submission after 5 days of due date will receive 0 points.

### **Make-up Work Policy:**

Make-up work will be given only in the case of a documented emergency. Note that make-up work may be in a different format than the original work, may require more intensive preparation, and may be graded with penalty points. If you miss an assignment and the reason is not considered excusable, you will receive a **zero**. It is therefore important to reach out to me—in advance if at all possible—and explain with proper documentation why you missed a given course requirement. Once a deadline has been established for make-up work, no further extensions or exceptions will be granted.

### **Incomplete Grade Policy:**

Incomplete grades may be requested only in exceptional circumstances after you have completed at least half of the course requirements. Talk to me immediately if you believe an incomplete is warranted. If granted, we will establish a contract of work to be completed with deadlines.

## G. Course Outcomes

### Knowledge and Comprehension

1. Understand and describe the layered design of protocol model
2. Working mechanism of application layer protocols: http, email, ftp, etc.
3. Understand the unreliable and reliable transport protocols along with various flow control and error control mechanisms
4. Understand routing protocols, network filtration techniques, and network virtualization
5. Learn the importance of network and data plane segregation in SDN
6. Understand security implications of various protocols at each layer

### Application and Analysis

1. Compare performance of both reliable and unreliable transport protocols.
2. Design addressing mechanism for predefined local area network
3. Analyze and evaluate a number of data link, network, and transport layer protocols
4. Capture and process the live network traffic for deep packet analysis

### Synthesis and Evaluation

1. Program network communication services for client/server and construct network filtering components.
2. Design and implement a reliable transport protocol using network programming interface (e.g. datagram sockets)
3. Evaluate performance metrics of the implemented reliable transport protocol

## H. Course Communication

- **Office Hours:** Tuesdays and Thursdays: **1-2pm**, Mountain Standard Time
- **Email:** UTEP e-mail is the best way to contact me, in case you were not able to meet during office hours. I will make every attempt to respond to your e-mail within 24-48 hours of receipt. When e-mailing me, be sure to email from your UTEP student account and please put the course number in the subject line. In the body of your e-mail, clearly state your question. At the end of your e-mail, be sure to put your first and last name, and your university identification number.
- **Discussion Board:** If you have a question that you believe other students may also have, please post it in the Help Board of the discussion boards inside of Blackboard. Please respond to other students' questions if you have a helpful response.
- **Announcements:** Check the Blackboard announcements frequently for any updates, deadlines, or other important messages.

## I. Standards of Conduct

Students are expected to conduct themselves in a professional and courteous manner, as prescribed by the Standards of Conduct. Students may discuss work assignments and programming exercises in a general way with other students, but the solutions must be done independently. Similarly, groups may discuss group project assignments with other groups, but the solutions must be done

by the group itself. Graded work should be unmistakably your own. You may not transcribe or copy a solution taken from another person, book, or other source, e.g., a web page. Professors are required to -- and will -- report academic dishonesty and any other violation of the Standards of Conduct to the Dean of Students. Some **key points** to remember:

- Always consider audience. Remember that members of the class and the instructor will be reading all the postings.
- Respect and courtesy must be provided to classmates and to instructor at all times. No harassment or inappropriate postings will be tolerated.
- When reacting to someone else's message, address the ideas, not the person. Post only what anyone would comfortably state in a F2F situation.
- Blackboard is not a public Internet venue; **all postings to it should be considered private and confidential.** Whatever is posted on in these online spaces is intended for classmates and professor only. Please do not copy documents and paste them to a publicly accessible website, blog, or other space. If students wish to do so, they have the ethical obligation to first request the permission of the writer(s).

## J. Copyright Statement for Course Materials

All materials used in this course are protected by copyright law. The course materials are only for the use of students currently enrolled in this course and only for the purpose of this course. They may not be further disseminated.

## K. Policy on using Artificial Intelligence (AI) Tools

Use of AI technologies or automated tools, particularly generative AI such as [ChatGPT](#) or [DALL-E](#), is **not allowed** for assignments/reports in this class. Each student is expected to use critical and creative thinking skills to complete tasks and not rely on computer-generated ideas. Any direct use of AI-generated materials submitted as your own work will be treated as plagiarism and reported to the Office of Student Conduct and Conflict Resolution (OSCCR).

### Using AI for brainstorming

Some AI technologies or automated tools, particularly generative AI such as [ChatGPT](#) or [DALL-E](#), can be beneficial during the early brainstorming stages of an activity, and you are welcome to explore them for that purpose. However, keep in mind that AI-generated ideas are not your own and may hinder your ability to think critically and creatively about a problem. It is also important to remember that these technologies often “hallucinate” or produce materials and information that are inaccurate or incomplete—even providing false citations for use.

That said, you are not allowed to submit any AI-generated work in this course as your own. If you use any information or materials created by AI technology, you are required to cite it like you would any other source. Consider how this will affect your credibility as a writer and scholar before doing so. Any direct use of AI-generated materials submitted as your own work will be treated as plagiarism and reported to the Office of Student Conduct and Conflict Resolution (OSCCR).

## L. Academic Dishonesty and Code of Honor

Academic dishonesty is strictly prohibited and is considered a violation of the UTEP Handbook of Operating Procedures. It includes, but is not limited to, cheating, plagiarism, and collusion. Cheating may involve copying from or providing information to another student, possessing unauthorized materials during a test, or falsifying research data on laboratory reports. Plagiarism occurs when someone intentionally or knowingly represents the words or ideas of another as one's own. Collusion involves collaborating with another person to commit any academically dishonest act. Any act of academic dishonesty attempted by a UTEP student is unacceptable and will not be tolerated. All suspected violations of academic integrity at The University of Texas at El Paso must be reported to the [Office of Student Conduct and Conflict Resolution \(OSCCR\)](#) for possible disciplinary action. To learn more [HOOP: Student Conduct and Discipline](#).

**Note:** Students are required to agree to the UTEP College of Engineering's [Honor Code](#).

## M. Accommodations Policy

The University is committed to providing reasonable accommodations to students with documented disabilities. Students who become pregnant may also request reasonable accommodations, in accordance with state and federal laws and regulations and University policy. Accommodations that constitute undue hardship are not reasonable. To make a request, please register with the UTEP Center for Accommodations and Support Services (CASS). Contact CASS at 915-747-5148, email them at [cass@utep.edu](mailto:cass@utep.edu), or apply for accommodations online via the CASS portal.

## N. Student Resources

UTEP provides a variety of student services and support. Please refer to the QR code below for a listing of campus resources.

