COURSE SYLLABUS

1 ECE 4470 - Computer Networks

2 Meeting Information

4 credits, 5 contact hours (Two 75-minute lectures, one 100-minute practicum weekly)

a. **Section 001:**
Lecture: MW 1:55 pm to 03:10 pm, **Tol 310C**
Lab: Tue 5:00 pm to 6:40 pm, **Vasey 204**

b. **Section 002:**
Lecture: MW 3:20 pm to 4:35 pm, **Tol 212**
Lab: Tue 1:30 pm to 3:10 pm, **Tol 305**

3 Course Instructor(s), TA(s)

a. **Section 001:**

Class Instructor:	Dr. Sarvesh Kulkarni
Office Hours:	MW 11:00 am - 12:30 pm, or by appt.
Lab Instructor:	Dr. Sarvesh Kulkarni
Office Hours:	MW 11:00 am - 12:30 pm, or by appt.
TA(s):	
Owen Saad	osaad@villanova.edu
Office Hours:	Mon, Wed 12:00 pm - 1:30 pm, or by appt.
Room:	Tol 425

b. **Section 002:**

Class Instructor:	Dr. Sarada P. Gochhayat
Office Hours:	Tue, Thu, Fri 12:00 pm - 1:30 pm, or by appt.
Lab Instructor:	Dr. Sarada P. Gochhayat
Office Hours:	Tue, Thu, Fri 12:00 pm - 1:30 pm, or by appt.
TA(s):	
Owen Saad	osaad@villanova.edu
Office Hours:	Mon, Wed 12:00 pm - 1:30 pm, or by appt.
Room:	Tol 425

4 Textbook

L. L. Peterson and B. S. Davie, *Computer Networks - A Systems Approach, 5th ed.* , Morgan Kaufmann, 2012. ISBN: 978-0-12-385059-1. REQUIRED.

a. **Other Supplemental Materials:** Class slides and notes (will be posted on Blackboard)

b. **Misc. Notes:**
Thanks to Villanova's Affordable Materials Project (AMP), get the textbook FREE HERE. This link is also posted on the Blackboard page for the course. The O'Reilly Media mobile

app (iOS, Android & Amazon Fire) allows you to read the textbook online/offline and syncs your progress and highlighted material across devices. Printed copies are not free.

5 Specific Course Information

a. **Catalog Description**
ISO/OSI, TCP/IP reference models; data transmission, encoding, framing, error detection, stop-and-wait, sliding windows; CSMA/CD, Ethernet; bridges, spanning tree protocol; connectionless, connection-oriented and source routing, IP addressing, forwarding, VPNs; switching fabrics; ARP, DHCP, DV, OSPF, BGP, DNS.

b. **Prerequisites:** ECE 1620 or CSC 2405; **Co-requisites:** None

c. Required for B.S. Computer Engineering

6 Learning Objectives

a. At the conclusion of this course, students are expected to: Acquire a broad understanding of the principles of architectural design and operation of contemporary, wired, packet-switched computer networks; Be acquainted with the hardware, software and design tradeoffs in current-day networks; Understand how network protocols at different levels inter-operate with each other and their role in a much larger world-wide system; Be acquainted with the social, economic and cultural impacts of this world-wide system; Learn the use of common network analysis tools; Implement a simple but fully working protocol on Ubuntu Linux in C (or C++) using the gcc (or g++) open source compiler.

b.

ABET Student Outcomes						
1	2	3	4	5	6	7
X		X	X		X	

The above student outcomes are defined by the Accreditation Board for Engineering and Technology (ABET) as:

1. an ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
3. an ability to communicate effectively with a range of audiences
4. an ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
6. an ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions

7 List of Covered Topics

1. The ISO-OSI and the TCP/IP reference models for communication, functions of individual layers, data movement between layers, protocols and their relationship to layers
2. PHY data transmission: wired media and wireless media; basics of modulation; NRZ, NRZI, Manchester and 4B/5B encoding; the Nyquist and Shannon-Hartley theorems (without proof) and their application

3. Data Link layer: framing; error detection using 2-D parity, checksum and Cyclic Redundancy Check (CRC); error recovery - stop-and-wait & sliding window protocols; CSMA/CD and case study of Ethernet; Learning bridges and Spanning Tree Protocol (STP)
4. Network layer: virtual circuits, datagrams, source routing; intra-domain routing algorithms - Distance Vector (DV), Open Shortest Path First (OSPF); inter-domain routing Border Gateway Protocol (BGP); IP addressing with classes, Classless Inter-Domain Routing (CIDR); IP subnets, masks, route lookups; switching fabrics and network processors
5. Protocols - ARP, DHCP; Private communication - Virtual Private Networks (VPNs)
6. Name resolution - Domain Name Service (DNS) architecture, records, and usage
7. Laboratory topic 1: Design/implement simple file transfer protocol over UDP by programming in C or C++ using gcc/g++ compiler on Ubuntu Linux
8. Laboratory topic 2: Network analysis tools - ping, route, traceroute, ss and wireshark

8 Tentative Schedule

Tentative schedules for all sections follow. Be sure to refer to the schedule for your specific section, if more than one is provided.

Tentative Schedule for **All Sections**

Week #	Dates	Topics of Study
1	1/18 - 1/20	Introduction; common terms; network characteristics & general classification - LAN, MAN, WAN; **1/11: no lab**
2	1/23 - 1/27	Wired & wireless connection characteristics; network topologies; circuit and packet-switching; error classification; services and functions of communication hardware/software; layers, protocols & services; ISO-OSI reference model
3	1/30 - 2/3	TCP/IP reference model; model differences; network evolution with illustrations; performance measurements and metrics; delay-bandwidth product and its significance
4	2/6 - 2/10	Mon, 2/6: Quiz 1; *ping* tool; PHY layer: transmission media & their characteristics
5	2/13 - 2/17	Information theory: Nyquist and Shanon-Hartley theorems with examples; data transmission: modulation, encoding
6	2/20 - 2/24	Mon, 2/20: Quiz 2; DL layer: framing; error detection: parity, checksum, CRC
7	2/27 - 3/3	Open free-form discussion: ethical, societal, global and economic impacts; Wed, 3/1: Midterm Exam
8	3/6 - 3/10	**Spring break**
9	3/13 - 3/17	Error recovery with ARQ: stop-and-wait & sliding window protocols
10	3/20 - 3/24	Ethernet, channel access using CSMA/CD; intro to switching/routing
11	3/27 - 3/31	Mon, 3/27: Quiz 3; ISO-OSI switching/routing: datagram, VC, source-based; learning bridges
12	4/3 - 4/7	Bridges contd: STP Protocol for breaking loops; Internet layer (IP): protocol, packet format, fragmentation / defragmentation, addressing (classes, public & private) **4/{6-10} Easter break**
13	4/10 - 4/14	IP protocol details: packet forwarding, masks & subnets, solved subnetting example, CIDR
14	4/17 - 4/21	Mon, 4/17: Quiz 4; Related protocols: ARP, DHCP, ICMP; IP tunnels & VPNs
15	4/24 - 4/28	IP routing: DV, OSPF, BGP; DNS: architecture & records
16	5/1 - 5/3	Switching fabrics; network processors; final review (if time permits); **5/3: final class day; 5/5: reading day**
17	5/8- 5/12	Final Exam: Thu, 5/11 from 11:30 am - 2:00 pm in TBD

9 Grading Policy

Homework: 10% weightage
Laboratory: 25% weightage
Quizzes: four quizzes, 20% total weightage
Midterm Exam: 20% weightage
Final Exam: 25% weightage

The final grading curve uses composite scores and will reflect a class average of *B*. Regardless of the grading curve, a student with a compostite score of 90+ will be awarded an *A* grade while a student with a composite score of less than 50 will be awarded an *F* grade. *In addition, in order to pass this course, a student's aggregate lab score (i.e. the sum of all laboratory assignment scores) must be at least 50%.*

10 HW Assignment and Laboratory Report Submission Policy

HW assignments and laboratory reports must be uploaded to **"Blackboard"** by the posted deadline. Late assignments/reports will be assessed a 10% penalty per day, up to the cut-off date (usually three days later). After the cut-off date, assignments/reports WILL NOT be accepted. You may turn in incomplete work to receive partial credit.

You may work in groups and discuss your general solution approaches with others. However, you may not show each other your written solutions or share the details of your work. Code sharing is forbidden.

No laboratory sessions will be held for the first two weeks of the semester. Be sure to maintain a working Linux partition on your laptop with functional *C* and *C++* compilers (i.e. gcc & g++). And do backup your work - your grade depends on it!

11 Attendance Policy

The full version of the official Villanova class attendance policy is posted at https://live-villanova-catalog.cleancatalog.io/class-attendance, but the main points are as follows.

A roll call will not be taken at the start of each class. However, you are expected to attend ALL classes unless officially excused. Since examination questions will be based on the material taught in class and the prescribed reading from the course textbook, missing classes will put you at a severe disadvantage. So, attend all classes, and be sure to take notes attentively.

Whenever possible, students should inform the instructor if they plan to be late or absent from class. In all cases, documentation is required to petition for *excused* absences to the Associate Dean for Student and Strategic Programs, Dr. Stephen Jones. The excused absence form is posted at: https://forms.office.com/r/H2kbHKLUmw.

Excused absences do not count towards a failure in the course for first year students. Absence from class does not release the student from assigned work. Students who miss an in-class obligation such as an exam, a presentation, etc., due to an excused absence will not be penalized - the instructor may offer a make-up test, arrange an alternative time for a presentation, exempt a student from the assignment, or provide another arrangement. In the case of illness or injury, the form must be submitted within 24 hours of missing a class. The University's list of excused absences for all students includes the following:

1. Participation in NCAA athletic competitions
2. Participation in special academic events such as: conferences, field trips, project competitions, etc., and in official university business such as student representatives attending meetings related to university governance
3. Attendance at significant events of the immediate family such as: funerals, weddings, etc.
4. Religious holidays - see the University's policy on Religious Holidays
5. College-approved participation in placement activities such as: job interviews, graduate school interviews, job fairs
6. Legally required absence such as: jury duty, court appearance, short-term military service
7. Documented serious illness or disability

12 Examination Policy

The College of Engineering has adopted the following general examination guidelines:

1. Students must arrive before the start of the examination. Under exceptional circumstances a student may need to arrive late, but he/she can enter the examination room no later than five (5) minutes after the start of the exam.
2. Cell phones must be turned off until the student exits the examination room.
3. The official Villanova class attendance policy must be followed when requesting excuses for absences or lateness to an examination.
4. Each student must write and sign the following statement, "I have neither given nor received any unauthorized assistance in the completion of this examination."
5. For online examinations, the instructor may implement video proctoring or other measures to ensure academic integrity. For consent purposes, the instructor will inform students in advance if (s)he plans to use any form of video-proctoring and whether the examination will be recorded.

13 Academic Integrity Policy

The College of Engineering is committed to creating an environment of academic integrity and ethical decision-making that we hope is reflected in the actions of our students and graduates. As Villanova students, integrity is central to the University mission. As engineers, our code of conduct requires us to place honor and integrity at the forefront of everything we do. As engineering students, it is expected that you will begin to adopt these values and instill them into your work habits. Students violating the academic integrity policy will receive a zero on that assignment or exam and the violation will be reported to the Associate Dean for Academic Affairs. The University's academic integrity policy can be found on the following web page:
https://live-villanova-catalog.cleancatalog.io/academic-integrity-0.

14 Adherence to the Student Code of Conduct

Students are expected to act in a professional and respectful manner to their fellow students, faculty, and staff. Students should become acquainted with and understand the responsibilities set forth in the Student Handbook, especially those in the sections on Policy and Regulations. Adherence to university regulations is expected and required for successful completion of the program of studies. Enforcement within the classroom of policies regarding classroom behavior is the responsibility of the faculty member. All other discipline problems are to be referred to the Dean of Students.

15 Inclusive Classroom

This classroom is a place where you will be treated with respect; we welcome individuals of all ages, backgrounds, beliefs, ethnicities, gender, gender identities and expressions, sexual orientation, and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming, and inclusive environment to allow all among us to learn and flourish.

16 Students with Disabilities

It is the policy of the university to make reasonable academic accommodations for qualified individuals with disabilities. If you are a person with a disability (non-physical) please register with

the office of Learning Support Services (LSS) by emailing Learning.support.services@villanova.edu or by phoning 610-519-5176 as soon as possible. Registration is *required* in order to receive accommodations. In addition, please contact the instructor during office hours in order to make the appropriate arrangements.

The Office of Disability Services (ODS) collaborates with students, faculty, staff, and community members to create diverse learning environments that are usable, equitable, inclusive and sustainable. The ODS provides Villanova University students with physical the necessary support to successfully complete their education and participate in activities available to all students. If you have a diagnosed disability and plan to utilize academic accommodations, please contact and register with Gregory Hannah, advisor to students with disabilities at 610-519-3209 or visit the office on the second floor of the Connelly Center.

17 Tutoring Services

Villanova's tutoring services include The Writing Center, The Learner's Studio, and The Center for Speaking and Presentation. These services are offered free of charge to students. Drop in as-needed or book a regular weekly session to supercharge your academic success. Sessions can be 30 or 60 minutes in length.

Register for an account and book sessions in advance at villanova.mywconline.com. If you don't see your class listed, request a tutor for a missing subject at: tutorrequest.villanova.edu For more information, contact Juliana Struder at juliana.studer@villanova.edu or at 610-519-5862.

18 Online Expectations

Some or all sessions of this class may be recorded for educational purposes and for later playback. In order to foster a professional environment, please wear appropriate clothes, refrain from eating, mute your microphone if you are not talking to eliminate background noise and select an appropriate setting free of distractions. You may turn off your webcam for privacy reasons unless explicitly instructed not to do so by the instructor (such as during the conduct of online examinations).

19 Electronics Policy

The use of electronic devices, such as phones, laptops, tablets, calculators, etc., during class is generally allowed, unless their use causes a disturbance to others. During examinations, the use of any electronic device is prohibited, unless it is expressly authorized by the instructor.

Students are prohibited from making any audio or visual recordings (including taking photographs) of lectures, discussions, or other classroom activities, unless a student (1) has written permission in advance from the instructor, or (2) is permitted to record under terms and conditions as approved by the University's Office of Disability Services or Learning Support Services. Students who have received approval to record classes as an academic accommodation must provide supporting documentation from the Office of Disability Services or Learning Support Services in advance of any recording. Students may use authorized recordings only for the purposes of individual study in the course, and may not disseminate or share them with a wider audience without explicit permission.

20 Copyright Policy

The materials used in Villanova University courses ("Course Materials") generally represent the intellectual property of course instructors, third parties and/or the university which may not be

disseminated or reproduced in any form for public distribution (e.g., sale, exchange, etc.) without the written permission of the course instructor. Course materials include all written or electronic documents and materials, including syllabi, current and past examination questions/answers, and presentations such as lectures, videos, slides, etc., provided by a course instructor. Course materials may only be used by students enrolled in the course for academic (course-related) purposes.

Published course readings (book chapters, articles, reports, etc.) available in "Blackboard" are copyrighted materials. These works are made available to students through licensed databases or fair use. They are protected by copyright law, and may not be further disseminated or reproduced in any form for distribution (e.g. uploading to websites, sale, exchange, etc.) without the permission of the copyright owner.

Follow these links for more information on Intellectual Property, Copyright, and Computer Acceptable Use.

21 Professorial Duties

It is important to note that teaching is one of the many duties that professors perform as part of their job responsibilities. In addition to teaching, professors perform research, advise graduate students, edit journals and review journal articles, serve on committees for the university and professional societies, travel to conferences to remain abreast of current developments and to present their results... to name just a few commitments.