

ELEN 525 – Telecommunication Theory and Applications

Overview:

Emphasis is on the physical and data link layers of the OSI telecommunications model. Also known as the fiber and packet layers, these topics deal with the physical aspects and lower level protocols of telecommunication networks including modulation formats, network efficiencies and throughput, fiber and copper cabling, media access control protocols, multiplexing and fundamental aspects of hauling data, voice and video traffic over LANs, MANs and WANs with examples drawn from POTS, Ethernets, the Internet, Fiber-To-The-Home and hybrid fiber/coax networks. The requisite mathematics is developed without assumption of prior knowledge. Prerequisites: none.

Topics will include:

General characteristics of traffic and networks

Normalized propagation delay, throughput and efficiency of high speed computer data networks
Delay and accuracy requirements of networks for hauling computer data, voice and video traffic

Network architectures and MAC (media access control) protocols

Examples include 802.3 and Gigabit Ethernet; 802.5 Token Ring; FDDI; Frame Relay; and ATM
The Internet, VoIP, IPTV, CATV, ADSL, POTS, LTE and 4G wireless networks, SONET

Physical layer constraints and requirements

Thermal noise, shot noise, dispersion, multipath fading, nonlinearities and their mitigation
Fiber and copper attenuation, reflection, standards, SNR, bit-error-rate, inter-symbol-interference

Multiplexing and modulation

Time division multiplexing, frequency division multiplexing, statistical multiplexing, DWDM
Data rates, frequency bandwidths and modem architectures in AM, FM, PSK, and QAM systems

Wireless standards and technologies

Multipath and flat fading compensation via adaptive equalizers, space diversity and regenerators
WiMax, CDMA, cellular networks, 4G systems, OFDMA, Bluetooth, software defined radio

Optical fiber and hybrid fiber/coax standards and technologies

Fiber to the curb (FTTC), FTTH, Raman fiber amplifiers, EDFAs, photonic crystal fiber, FBGs,
dispersion compensating fiber, solitons, DWDM add/drops, limits and emerging technologies

Course grading:

There will be two exams (each at 30% of the course grade) and a term paper (also at 30%). Although the homework only comprises 10% of the course grade, these are imperative since they provide the problem solving practice necessary for learning, and hence doing well on the exams. Since the telecommunications industry is one of rapid change, it is vital that our students learn how to read and skim technical and trade journals; and learn how to summarize and convey this information in a simple way. The term paper serves to initiate this lifelong learning process. Therein the student is free to focus on the regulatory, industrial and/or technical aspects of any topic (related to the above) that they wish to study at greater depth.

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| Midterm Exam | 30% |
| Final Exam | 30% |
| Homework | 10% |
| Term Paper | 30% |

Term papers

These should be written to convey the information in the simplest and most direct way. Imagine that this is a brief report to your administrator on some topic you've researched. (S)he just needs to understand as much as possible – quickly. There is no place in technical writing for “flowery writing” and so-called “big words” should only be used if they are the best way to quickly get to the point. Further guidance will be given in lecture and via email. There are no page limitations but it would be difficult to write a “good one” that's less than three pages or more than ten. References must be carefully acknowledged and resources (websites, journals, search engines) will be presented in lecture. Guidance will also be provided, if needed, in identifying a topic.

Homework and exams

These will be administered via Moodle. Homeworks are designed to give the students a learning experience – a place to “splash around and learn to swim.” Often a student goes away from a clear lecture with great comprehension, but it is only when that student sits down and applies that knowledge to the solution of real problems that the student is fully empowered. Just like how we learn to swim – it takes practice. That's what the homeworks are for. After an honest individual attempt at doing well on these and learning from mistakes – *any* student will be well prepared to do well in their career (as well on the exams). Homework will be available for one week, during which the student can continue to work on it before submitting it. Exams will be in a similar format, with one week of opportunity to open the exam, however once the exam is opened the student will have three hours to complete it and submit it. The exams are designed to be readily completed within one hour so as to give ample time for checking your answers. “Quickness” will not be a factor on the exams – they will only test your *understanding* of the material. Make-up exams will be created in the case of documented emergency, but to be fair to the rest of the class these would have to be *at least as difficult* as the ordinary exam. Late homework cannot be accepted, but in the case of documented emergency, we will replace a zero with your average.

Text and references

There is no required text. Telecommunications changes so rapidly that by the time a text is published it's already out of date. Also, this course is an overview of a wide variety of topics; whereas most texts give an in-depth treatment of a narrower range of topics. Online references (including resources from the IEEE Communications Society) will be presented in lecture. In addition, the following texts will be placed on reserve in the library:

W. Stallings, “Data and Computer Communications,” 2006, Prentice Hall;

A. B. Carlson, et. al., “Communication Systems,” 2009, McGraw Hill;

G. P. Agrawal, “Fiber-optic Communication Systems,” 2010, John Wiley & Sons.

Professionalism and ethics

Academic dishonesty in any form will not be tolerated. Violations of student academic behavior standards are outlined in the Louisiana Tech University Student Handbook. See latech.edu/ for further details. Students are encouraged to discuss course *concepts* (during and outside of class, as well as in online discussion boards) but NOT homework answers before due dates; since this would only rob your friend of the learning experience needed to do well on exams. That would also hurt the “helper's” standing since grades are curved according to a clustering procedure which will be described in lecture. Ethics and professionalism are important – particularly in the telecommunications industry – and these principles will be reinforced throughout the course (including examples of tragedies resulting from executives who did not follow these principles). References must be carefully acknowledged to avoid plagiarism and students will gain experience on how to do so in the term paper. Also, all cell phones should be turned off (or put on silent ringer) during lecture as a matter of courtesy to the other students.