The Physics Behind the Internet – PHY155 – Winter 2004
Tues, Thurs, 10:00 – 11:50 pm, Will. Hall, Room 110
Prof. Michael Raymer, Will 262 (346-4785) raymer@oregon.uoregon.edu
Brian Smith, PhD Candidate, Will 242 (346-4726) bsmith4@darkwing.uoregon.edu
Emelie Harstad, Grad. Teaching Assistant, Will 216 (346-4770) eharstad@darkwing.uoregon.edu
Office Hours: TBA

Course URL: http://blackboard.uoregon.edu (student access only)

COURSE DESCRIPTION - A non-major's science course to introduce the physical concepts necessary to understand how information is stored, transmitted, processed, and retrieved. Fundamental issues in physics will be discussed using only elementary math and simple algebra.

Required Text – None.
Required Course Packet – The Silicon Web - The Physics Behind the Internet (course packet notes by M.R.)
Readings – TBA
Attendance - Since there is no text, and there will be some demos, attendance of all lectures is essential to learning the subject.

Grading -
Weekly Homework: 25%, you may work together on this.
Quiz 1 (Jan.29): 10%,
Quiz 2 (Feb.19): 10%,
Term Paper (due Mar.4): 25%, this must be independent work.
Final Exam (Wed. Mar.17, 8:00 – 10:00 am, Will 110): 30%

→ Correction -- Homework Policy - All assignments are due by 10:00 am on the due date. Assignments will be accepted up to 24 hours late (10:00 am), but will receive at most 80% credit. Assignments more than 24 hours late will earn no credit.

Official Notices:
1. “All acts of alleged academic dishonesty will be reported to the university’s student conduct officials.”
2. “If you have a documented disability and anticipate needing accommodations in this course, please make arrangements to meet with me soon.”
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The Internet is a network of millions of computers capable of exchanging data files containing information. The technology that makes this possible is the result of the efforts of tens of thousands of physicists, engineers, and computer scientists over more than a hundred years. The development of the Internet is an amazing story of the transformation of fundamental physics discoveries into practical systems.

SOME BIG QUESTIONS –
• Signals - why digital and not analog?
• What is Information?
• How is Information stored and retrieved electronically?
• How is Information processed by an electronic computer circuit?
• How is Information transmitted through wires or optical fibers?
• Why does optical fiber have a much greater capacity for transmitting Information than does wire?
• What is Bandwidth and why is having a lot of it a good thing?

This course will emphasize the Physical Science Context –
• What are the fundamental discoveries in the physical sciences that enabled the Internet to be invented?
• How can we understand these discoveries using a minimum amount of mathematics?

We will also discuss in far less detail some elements of computer science needed to understand how the physics-based devices go together to make up the Internet. And we will treat to a small degree the historical context. Who made these fundamental discoveries and why?

THE FUNDAMENTAL DISCOVERIES –
• Electromagnetism – electric and magnetic forces; electromagnetic waves (light, radio)
• Theory of Logic
• Electronic circuits, semiconductors, and transistors
• Electronic logic implementation
• LASER (light amplification by stimulated emission of radiation)
• Mathematics of spectral analysis/ synthesis and sampling
• Special materials – semiconductors; optical fibers; magnetic materials

THE PRACTICAL DEVICES –
• Telegraph, telephone, radio
• Magnetic data storage devices – tape, disks
• Optical data storage disks – CDs (read/ write)
• Communication channels – wires, air, optical fibers
• Communication transmitters – circuits, lasers
• The microprocessor
• Data compression (JPEG, MP3)
PHYSICS BEHIND THE INTERNET - PHYSICS 155/W2004
COURSE SYLLABUS
Michael Raymer, Professor of Physics

Required Text - none
Required course Packet – buy at UO bookstore, also available on the Blackboard site.

WEEK 1 (JAN.5-9) Binary numbers and Networks
(text ch. 1 and ch.2)

WEEK 2 (JAN.12-16) Networks and Logic
ch.2 and 3

WEEK 3 (JAN.19-23) Logic, Electromagnetism
ch.3, ch.4 (first half)

WEEK 4 (JAN.26-30) Energy, Logic Circuits, Electrons, Atoms
ch.4, ch.5 (first half)

WEEK 5 (FEB.2-6) Atoms, crystals, Semiconductors
ch.5, ch.6 (first half)

WEEK 6 (FEB.9-13) Semiconductors and Memory
ch.6, ch.7

WEEK 7 (FEB.16-20) Light
ch.8, ch.9
QUIZ 2 - FEB.19

WEEK 8 (FEB.23-27) Light and Lasers
ch.9, ch.10, ch.11

WEEK 9 (MAR.1-5) Communication Systems
ch.11, ch.12
TERM PAPER DUE MAR.4

WEEK 10 (MAR.8-12) Optical Communication Hardware
ch.13

WEEK 11 - Final Exam 8:00 am Wed Dec.10 Willamette 110