PHYSICS 204 - Physics for Computer Science II, Sections 1,2,3

Aims of the Course:
1. To understand the principles of Physics that can help you design Computer Software and Hardware.
2. To give you experience in thinking to solve problems. Engineers solve (real world) problems.

Lecture/Recitation: Tuesday & Thursday, 2:15–4:05 PM in Science Building Room C205
Dr. Larry Liebovitch: http://people.qc.cuny.edu/Faculty/Larry.Liebovitch/
Office Hours: Tuesdays/Thursdays 1:15 PM - 2:15 in SB B322

Textbook (REQUIRED):

Michael G. Raymer. The Silicon Web: Physics for the Internet Age. (Taylor & Francis, 2009).

Other Sources (not required):

Barabasi. Linked. (Perseus Publishing, 2002).
Hecht. College Physics, 11th Ed. (Schaum's Outlines, 2012)
Liebovitch & Shehadeh. Fractals&Statistics (DecoBytes, 2003)
https://drive.google.com/drive/u/0/folders/0B3t7HoVL1Ct7RTJucGxtVHJOeW8
Liebovitch. Fractals and Chaos: Simplified for the Life Sciences (Oxford University Press, 1998).
Mazzucato. The Entrepreneurial State: Debunking Public vs. Private Sector Myths (Anthem, 2013).
Mermin. Quantum Computer Science. (Cambridge University Press, 2007).

My Lecture Videos and other materials will be posted at:

https://drive.google.com/drive/u/1/folders/0BxKjzHTZ7PXHUElMY2t6MFhxajg

Attendance in Lecture and Recitation is required and attendance will be taken

Grading Policy:

Recitation Problems: 20%
Done in class, no makeups
Exams: 20%
These will consist of problems similar to those in the Recitation Problems
Midterm: October 20, 2016: 10%
Final Exam: (TBA, December 14-21, 2016): 10%
Projects: 40%
TWO executable PROGRAMS illustrating physical concepts from the course, each WITH an explanatory VIDEO
#1 program/video due 2:15 PM Thursday 10/27/16; #2 program/video due 2:15 PM Thursday 12/08/16
Each Program (any computer language): 10%
Each Video (MUST not be longer than 4 minutes): 10%
Lab: 20%
Lab reports graded by the lab instructor

Week	Tuesday	Topic	Reference	Thursday	Topic	Reference
1				8/25/16	Introduction - Heat	Raymer: pp. 112-129
2	8/30/16	Scaling Laws	Liebovitch&Shehedah : Lectures 21-30	9/1/16	Recitation/Problems	
3	9/6/16	Networks	Barabasi: pp. 41-92	9/8/16	Recitation/Problems	
4	9/13/16	Dynamics (& chaos)	Liebovitch: pp. 115-241	9/15/16	Recitation/Problems	
5	9/20/16	Electricity & Magnetism	Raymer: pp. 141-180	9/22/16	Recitation/Problems	
6	9/27/16	Circuits	Hecht: 281-334	9/29/16	Recitation/Problems	
7	10/4/16	x	**No Classes**	10/6/16	x	**Monday Schedule**
8	10/11/16	x	**No Classes**	10/13/16	Recitation/Problems	
				FRIDAY 10/14/16	AC/DC	**Tuesday Schedule**
9	10/18/16	Recitation/Problems		10/20/16	**MIDTERM EXAM**	
10	10/25/16	Quantum Mechanics	Raymer: pp. 299-330	10/27/16	Recitation/Problems **#1 Program/Video Due**	
11	11/1/16	Quantum Devices	Raymer: pp. 319-374, 467-517	11/3/16	Recitation/Problems	
12	11/8/16	Algorithms, FFT	Mermin: 63-87	11/10/16	Recitation/Problems	
13	11/15/16	Algorithms, RSA, Apple Pay		11/17/16	Recitation/Problems	
14	11/22/16	Quantum Computing	Mermin: 35-62	11/24/16	x	**No Classes**
15	11/29/16	Artificial Intelligence		12/1/16	Recitation/Problems	
16	12/6/16	Technology	Mazzucato	12/8/16	Recitation/Problems **#2 Program/Video Due**	
	FINAL EXAM December 14-21, 2016					

Some More Details:

- Heat (Raymer: pp. 112-129)
  - cooling: the limits of computers and bicyclists
  - conduction, convection, radiation
  - the heat of bits, Feynman Figure 46-1
- Scaling Laws (Liebovitch&Shehedah: Lectures 21-30)
  - dimension, scaling, fractals
  - using fractals: storage, bandwidth, antennas, connections, error transmission
- Networks (Barabasi: pp. 41-92)
  - random, power law, small world
  - how they form
  - routers, IPs, the actors who did movies with Christopher Walken
  - real world analysis: motifs
- Dynamics (Liebovitch: pp. 115-241)
  - what they lied to you about in Physics for CS - I
  - chaos: butterflies, attractors and intermittency
  - computation: what works, what doesn't
- Electricity and Magnetism (Raymer: pp. 141-180)
  - E and M separately
  - E and M together
  - the truth about special relativity
- Circuits (Hecht: 281-334)
  - capacitors
  - resistors
  - Kirchoff's Laws
- AC/DC
  - war of the currents
  - beta v. vhs
  - tipping points
- Quantum Mechanics: basics (Raymer: pp. 299-330)
  - introduction: waves and particles
  - two slits: Heisenberg
  - Schrodinger Equation: probability waves
  - entanglement: teleportation (maybe) and Bell's theorem
  - band gaps: insulators, semi-conductors, conductors
- Quantum Devices (Raymer: pp. 319-374, 467-517))
  - amplifiers: downhill is easier than uphill
  - tubes(valves): triodes, and transistors: junction, MOSFET
  - LEDs, solar (photovoltaic) cells
  - Lasers: making light, talking over fibers
- Algorithms, FFT
  - FT (Fourier Transforms)
  - polynomials instead of 10^x
  - FFT (Fast Fourier Transforms)
  - how to multiply fast (with FFT)
- Algorithms, RSA, Apple Pay
  - RSA
  - near field commication (NFC)
  - Apple Pay
- Quantum Computing (Mermin: 35-87)
  - Why?
  - Quantum Hardware
  - Quantum Algorithms: Deutsch, Shor, Grover
- Artificial Intelligence
  - Artificial neural networks
  - Storing memories: Hopfield, feedforward
  - Training: supervised, unsupervised
  - Deep Learning: AI finally understands what you're saying on the phone
- Technology (Mazzucato)
  - Government vs. Entrepreneurs
  - Siri is: AI, GPS, chips, etc. research funded by the US government