**MITES 2008:: Physics III : Oscillations and Waves :: Course Syllabus**
**Massachusetts Institute of Technology**

**Instructor**: Hyun Youk
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- Lab: Rm. 68-359.
- Office Hours: (Day): Mon., Wed., Fri.: 12:30 PM - 1:15 PM in classroom (Rm. 1-134)
  (Evening): Mon, Tues. : 7-10 PM in Simmons Rm. 348 (lounge).
  For other times, just send me an e-mail. Since I work and live on campus, it is quite easy for me to come to Simmons' common study space on other evenings (including weekends) or meet you at other campus locations during the day.

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**Recitation Instructor**: Louis Fouche
- E-mail: ldfouche@alum.mit.edu
- Phone: 504-376-3526 (Cell). 617-577-5947 (Room).
- Simmons Rm. 344
- Office Hours: Mon, Tues. 8-10 PM, Thrs. 8-9PM, Fri. 7:30-8:30 PM in Simmons Rm. 348 (lounge).
  Other times by appointment.

**Lectures** take place on Mon, Wed., and Fri.: 1:15 PM - 2:45 PM in Rm. 1-134.
**Recitation** takes place on Thrs.: 2:30 PM - 3:30 PM in Rm. 1-134.
**Course web page**: http://web.mit.edu/hyouk/www/

**Course outline**:
1. Oscillations of a particle.
2. Oscillations of lots of particles together. (i.e. Waves).
3. Interaction between two (or more) waves. (i.e. Wave interference).
4. An important example of wave: Electromagnetic (EM) wave.
   - 4.1. How does an EM wave propagate in spacetime?
   - 4.2. "Spacetime"? (Einstein's special relatively – Basic concepts).
5. Another important example of wave: Matter wave.
   - 5.1. Blackbody radiation puzzle (end of classical physics).
   - 5.2. Particle-wave duality (Quantum mechanics – Basic concepts).
6. Other examples of waves in modern physics.
   - 6.1. Cosmology: Cosmic-microwave background radiation from the big bang.
   - 6.2. Biophysics: The ultimae nano-scale molecular clock in bacteria:
     "Circadian oscillator – Keeping tracking of time"

**Math that we will learn**:
- Differential equations: A tool for modeling and "simulating" dynamical systems.
- Linear algebra: Matrices, eigenvalues, and eigenvectors as tools for solving a system of multiple equations.
- Complex numbers: simplifies calculations and adds another "dimension" to real numbers.
- Fourier series and transformation: Decomposing almost everything into many waves.

**Math prerequisites**: Some previous exposure to calculus (taking derivatives and integrals) is a prerequisite for this class. But you don't have to be the ultimate calculus guru; we will review derivatives and integrals through physical examples as we go along. No previous exposure to matrices and differential equations is assumed. I will assume that most of you had minimal exposure to calculus before taking this class.

**Physics prerequisites**: Previous exposure to Newton's laws of motion, kinetic and potential energies, and kinematics is assumed for this class. But we will go over these concepts as we go along through physical examples. I will assume that most of you had about one to two semesters of physics covering the topics mentioned above, before taking this class.

**Evaluation**: Evaluation in this class is based on problem sets, "check-ins" (short quiz occuring at the beginning of some classes), midterm exam, and a final exam. Of these, I will place most weight on the problem sets. Roughly, the problem sets will be worth 50%, midterm will be worth 20%, final exam will be worth 20%, and the ”check-ins” will be worth 10%. But as with all your MITES classes, there will be no offical letter grade assigned to you at the end of our program. Instead, I will write a comprehensive report that includes your strengths and skills that I think you can improve on. So the breakdown of the grades listed above is very fluid. Basically, what I would like to see is that you try your best and that I see a significant improvement in your knowledge of physics over the next five weeks. This means that if you're having trouble with the material in our class, you should be proactive and contact me to ask for extra help through extra tutoring time, problems, etc. So please do not ever hesitate to ask me or Louis for extra help outside the class.

**Note about problem sets**: The only way to learn physics and math is working through lots of different types of problems. Just as you can't learn how to play the violin or the saxophone by reading sheet music or watching another person playing the instrument, you cannot learn any physics and math just by watching someone (your friend, your instructors) solving the problems for you, or by reading textbooks and lecture notes. You must think through a problem, write down equations and physical principles to solve it, and then go over your solution to make sure you understand the physics behind the problem. By all means, I encourage you to work with your classmates on the problem sets. But you should **always** write your own solutions (not copying your friend's solutions).