Introduction to Oscillations and Waves

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Class assignments:

- SI 20-22; SII,SIII 01-03,09-10   Monday, 9:00 - 10:30 am at Rm. 576
- SI 07,10; SII,SIII 13,15,18   Wednesday, 13:00 -14:30 pm at Rm. 741

Course description:

Oscillations and waves are universal phenomena which appear in various areas of physical sciences, such as mechanics, electromagnetism, fluid mechanics, optics, and quantum mechanics. We can also find many familiar examples in our daily life; such as oscillation of swings, surface waves on the water etc. This is an introductory course to learn basic concepts and mathematical methods to describe these phenomena. This course is a prerequisite for students who wish to become a major not only in physics, chemistry, mathematics and engineering, but also in life sciences.

Grading

The grading will be based on the final exam to be scheduled in early February. During the course, some homework problem sets will be given.

Books recommended:

- A. P. French, *Vibrations and Waves* (The MIT Introductory Physics Series)(Norton, 1971).
- Y. Nagaoka, *Oscillations and Waves* (in Japanese) (Shokabo,1992)
- M. Ogata, *Oscillations and Waves* (in Japanese) (Shokabo Physics Text Series, 1999)

Tentative outline of the course:

1. Simple Harmonic Oscillation: harmonic oscillator in one-dimension, the principle of superpositions, rotation and complex exponentials, damped oscillator, forced oscillator, resonances, nonn-linear oscillation

2. Coupled Oscillations: two coupled oscillators, normal modes, superposition of modes and beats, many coupled oscillators, dispersion, continuum limit

3. Motions of Strings: derivation of the wave equation, boundary conditions, the method of Fourier decomposition

4. Wave propagation in one-dimension: d'Alembert's solutions, wave packets, phase velocity, dispersion and group velocity, superposition of waves, reflection and transmission of waves, stationary waves

5. Wave propagation in two and three dimensions: plane waves and spherical waves, Huygens' principle, reflection and refraction, diffraction, electromagnetic waves and polarization, matter waves and the uncertainty principle.