COURSE OUTLINE
Wave and Vibrations– Spring 2023
PHYS-104

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COURSE OBJECTIVES

This course is an introduction to the physics of vibrations and waves, beginning with the simple harmonic oscillator, the foundation to understanding oscillatory and vibratory systems. The course will include driven and damped single oscillators, coupled discrete oscillators, and continuous vibrating systems. Connections will be made with many areas of physics that involve oscillation, including mechanics, electromagnetism, and quantum mechanics. The main course objectives are to gain familiarity with basic analysis of oscillating systems, including Fourier and other methods, to learn the idea that waves are the natural excitations of any medium. This course can develop skill in applying mathematics in different physical situations and also can generate capacity for critical thinking and analysis.

LEARNING OUTCOMES

Through this course, the students will be able to:

1. Set up and solve the equations of simple, damped and forced harmonic motion
2. Explain elementary concepts in waves: wavenumber, frequency, traveling and standing waves
3. The role of boundary conditions in determining allowed modes of oscillation
4. Apply and solve the mathematical description of sinusoidal waves
5. Approximate more realistic anharmonic vibrations with simple harmonic oscillators
6. Perform basic harmonic analysis of a wave and solve problems involving pulses and wave groups
7. To develop breadth and depth of contemporary topics in classical and modern physics that emphasizes the experimental, theoretical, and interdisciplinary nature of physics.

COURSE OUTLINES

Study of the physical phenomena in mathematical terms, types of waves, mathematical representations, energy of waves, interference, diffraction and polarization. Laboratory

Course Materials:

1. French, A.P., Vibrations and Waves, Norton, New York, NY
2. Main, I.G., Vibrations and Waves in Physics, CUP, New York, NY
3. Pain, H.L., The Physics of Vibrations and Waves, Wiley, West Sussex, England

Course grading: Your final grade will be based on the following:

Quizzes	10%
Homework Assignments	10%
Laboratory	20%
Midterm Test	25%
Final Examination	25%
Project	10%
	100%

Syllabus and Tentative schedule:

Week	Learning Activity	LECTURE Notes SECTIONS	QUIZ/ASSIGNMENTS
1	Harmonic motion, Simple Harmonic Oscillator	Ch-1	
2	Damped simple Harmonic oscillations	Ch-2	**Assignment 1**
3	Forced vibrations and resonance	Ch-3	**Quiz 1**
4	Coupled Oscillators, superposition of modes	Ch-4	
5	Many couples Oscillators, Wave equation.	Ch-4	
6	Transverse travelling waves, Standing Waves	Ch-5	**Assignment 2**
7	Longitudinal Waves, Sound Cavities, Resonance Frequencies.	Ch-6	**Quiz 2**
8	Dispersion, phase velocity, Group Velocity	Ch-6	
9	Electromagnetic waves, polarization	Ch-8	**Assignment 3**
10	Dispersion, reflection and refraction	Ch-8	**Quiz3**
11	Accelerated Charges, Poynting Vector, Power, Rayleigh Scattering	Ch-8	
12	Index of Refraction, Reflection, Fresnel Equations, Brewster Angle	Ch-8	**Assignment 4**

13	Interference, Huygen's Principle. Double slit interference	Ch-12	**Quiz 4**
14	Diffraction, Gratings, Spectral & Angular Resolution	Ch-12	