# WAVES AND OSCILLATIONS

**PROF. M. S. SANTHANAM**
Department of Physics
IISER Pune

**PRE-REQUISITES :** Higher secondary school level Physics and Mathematics is preferred.

**INTENDED AUDIENCE :** Students of first year B.Sc (Physics / Mathematics ) and first year B.E courses.

**COURSE OUTLINE :**
This is a first course on the physics of waves and oscillations. All of our communication gadgets, musical instruments, electronic devices rely on wave phenomena. In this course, systematic theoretical background to the understanding of wave phenomenon in a wide spectrum of applications will be covered. Emphasis is placed on how theoretical ideas are applied in practice.

**ABOUT INSTRUCTOR :**
Prof. M. S. Santhanam is an Associate Professor of Physics at the Indian Institute of Science Education and Research, Pune. His research interests are in the areas of Chaos and Nonlinear Dynamcs, Quantum Chaos and Statistical Physics. He has obtained Ph.D in Theoretical Physics working at Physical Research Laboratory, Ahmedabad. He had been a post-doctoral fellow at Max Planck Institute for the Physics of Complex Systems, Dresden, Germany.

**COURSE PLAN :**

**Week 1**:Oscillations in physical systems, Time period and frequency, Harmonic oscillator in one-dimension and its solutions, Superposition of simple harmonic oscillations, Lissajous figures.

**Week 2:**Damped harmonic oscillations and its solutions. Driven and damped oscillator and its solutions. Applications to vibration isolation.

**Week 3**: Impedance, Displacement and velocity resonance, Q-factor of the oscillator.

**Week 4:** Coupled oscillations, Normal modes and frequencies.

**Week 5:** Coupled oscillations of loaded string, Solvable examples of coupled oscillations.

**Week 6:** Wave equation and the transverse waves, Solutions of wave equation, Velocities in wave motion.

**Week 7:** Standing waves, Reflection and transmission of waves at a boundary, Impedance matching.

**Week 8:** Longitudinal waves, Sound waves in gases, Longitudinal waves in a solid, Application to periodic structures and earthquakes. Experimental techniques to measure speed of sound.

**Week 9:** Fourier analysis, Wave pulses, Applications of Fourier analysis.

**Week 10:** Waves in optical systems, Laws of reflection and refraction, Rays and wavefronts.

**Week 11:** Interference and Diffraction, Newton's rings, Fabry-Perot Interferometer,Fraunhofer diffraction.

**Week 12:** Introduction to nonlinear oscillations, Waves and solitons.