

Wave Physics

- 1. Course number and name:** 020PHONI3 Wave Physics
- 2. Credits and contact hours:** 4 ECTS credits, 2x1:15 contact hours
- 3. Name(s) of instructor(s) or course coordinator(s):** Pascale Abboud, Elias Mechref, Georges Moussaed, Nader Kozhaya.
- 4. Instructional materials:** Course handouts, in-class problems.

5. Specific course information

a. Catalog description:

This course offers students a solid foundation for understanding the fundamental principles of sinusoidal waves, their propagation, and their significance in various applications. It covers essential concepts related to transverse mechanical waves through the study of progressive and standing waves on a string. The course further explores longitudinal mechanical waves, specifically focusing on sound waves in a tube and their behavior at points of discontinuity. Additionally, students engage in a comprehensive study of electromagnetic waves, including an examination of Maxwell's equations, with a particular emphasis on progressive plane waves in a vacuum. Furthermore, the course introduces students to seismic waves and their various types.

b. Prerequisites: 020SPHNI1 Physical Signals

c. Required/Selected Elective/Open Elective: Required

6. Educational objectives for the course

a. Specific outcomes of instruction:

- Understand the fundamental principles of waves, their characteristics, classification, and wave equation.
- Analyse the behaviour of sound waves in a tube.
- Describe the properties of the normal modes of a standing wave, such as frequencies, wavelengths, and harmonics.
- Understand the fundamentals of electromagnetism, including the concepts of electric field and magnetic field, their relationship in electromagnetic waves, and Maxwell's equations.
- Analyse the properties of a plane wave, including direction and speed of propagation, polarization, frequency, and wavelength.
- Use appropriate mathematical tools to solve problems involving electromagnetic waves.
- Understand the different types of seismic waves.

b. PI addressed by the course:

PI	1.2	1.3	7.1
Covered	x	x	x
Assessed	x	x	x

7. Brief list of topics to be covered

- Wave equation: Introduction to waves, Sinusoidal travelling wave. (5 lectures)
- Vibrating string: Equation of a vibrating string, The transport of energy by a wave, Wave at discontinuities. (5 lectures)
- Sound wave in a tube: A finite length tube, An infinite tube. (5 lectures)
- Standing waves: Normal modes of a vibrating string, Superposition of two travelling waves, The energy in a standing wave, The superposition of normal modes. (5 lectures)
- Seismic waves. (2 lectures)
- Vector analysis. (2 lectures)
- Electromagnetic waves: Electric charges and electrostatic field, Electric current and magnetic field, Maxwell equations, Wave equation in vacuum, Monochromatic EM plane wave, Polarization of light. (6 lectures)