BACHELOR 'S PROGRAMME
1st YEAR OF STUDY, 1st SEMESTER

COURSE TITLE	OSCILLATIONS AND WAVES
COURSE CODE	
COURSE TYPE	full attendance
COURSE LEVEL	1st cycle (bachelor's degree)
YEAR OF STUDY, SEMESTER	1st year of study, 1st semester
NUMBER OF ECTS CREDITS	6
NUMBER OF HOURS PER WEEK	5 (2 lecture hours + 3 seminar / laboratory hours)
NAME OF LECTURE HOLDER	Assoc. prof. Sebastian POPESCU, PhD
NAME OF SEMINAR HOLDER	Assoc. prof. Sebastian POPESCU, PhD,
PREREQUISITES	Advanced level of English language

A GENERAL AND COURSE-SPECIFIC COMPETENCES

General competences:

→ CT1. Identification of roles and responsibilities in a team and application of networking techniques and effective work within a team.

→ CT2. Efficient valorization of resources and learning and communication techniques for one's own development.

Course-specific competences:

→ C1. Identification and proper use of the main laws and physical principles in a given context.

→ C2. Solving of Physics problems in given conditions, using numerical and statistical methods

→ C3. Application of Physics knowledge in given situations in related fields, as well as in experiments, using standard laboratory equipment.

B LEARNING OUTCOMES

→ At the end of this class, the students will be able to:

→ Describe oscillating mechanical systems, using specific theories and tools (experimental and theoretical models, algorithms, schemes, etc.)

→ Derivation of working formulas for calculations with physical quantities using appropriate principles and laws for studying oscillations and waves.

→ Comparative assessment of the theoretical results offered by literature and of an experiment conducted in the framework of a professional project.

→ Application of the principles and laws of Mechanics in solving theoretical or practical problems, under qualified assistance conditions.

→ Elaboration of graphs and reports for explaining and interpreting physical results obtained by statistical methods.

→ Critical assessment of the results obtained by employing a physical model, including the degree of uncertainty of the obtained experimental results.

C LECTURE CONTENT

Mechanical equilibrium

- Mechanical equilibrium, dynamical conditions of equilibrium.
- Types of equilibrium, energetic conditions for equilibrium.
- Dynamic equilibrium. Effective potential energy.

Elastic properties of bodies

- Elastic bodies. Elastic force.
- Deformation of bodies to elongation/ compression. Strain and stress. Hook law.
- Deformation of bodies to shear.
- Deformation of bodies to torsion.
- Deformation of bodies to bending.

Oscillations

- Oscillations. Properties.
- Free oscillations. Free harmonic oscillations. Energy.
- Damped oscillations. The logarithmic decrement. Energy.
- Forced oscillations without damping.
- Forced oscillations with damping. Resonance. Quality factor.
- Superposition of parallel oscillations with the same frequency and with different frequencies. Beats.
- Superposition of perpendicular oscillations. Lissajous figures.
- Coupled oscillations. Normal modes.
- Fourier analysis of signals.

	Waves • General characteristics of waves, characteristic quantities of waves. • The wave equation, solution of the wave equation. • Plane, cylindrical and spherical waves. Energy and intensity. • Transverse waves. Propagation speed of a transverse wave. Characteristic impedance of a string • Longitudinal waves. Propagation speed of a longitudinal wave. Characteristic impedance of a solid. • Reflection and refraction of waves. Fresnel coefficients. Standing waves. • Wave interference. • Wave diffraction (Fraunhofer). • Wave absorption. • Wave dispersion. Rayleigh equation. Group velocity. Acoustics • Sound waves. Speed, energy and intensity of sound waves. • Doppler effect. • Standing acoustic waves. • Sound production. Sound qualities. Sound spectra. Ultrasounds and Infrasounds
D	RECOMMENDED READING FOR LECTURES
	• Arya, Introduction to Classical Mechanics, 2nd ed., Pearson, 1997. • Alonso, E. J. Finn, Fundamental University Physics, vol. I, Mechanics, Addison-Wesley, 1967. Supplementary reading: • H. D. Young, R. A. Freedman, A. L. Ford, Sears and Zemansky's University Physics, with modern Physics, 14th ed., Pearson, 2016.
E	SEMINAR / LABORATORY CONTENT
	Mechanical equilibrium Elastic properties of bodies Oscillations Waves Acoustics Study of elastic properties of bodies. Determination of gravitational acceleration with a physical pendulum. Determination of inertia momentum against an axis using a torsion pendulum. Superposition of perpendicular oscillations. Determination of sound speed using Lissajous figures. Study of damped oscillations. (Pohl pendulum) Study of forced oscillations. (Pohl pendulum). Study of coupled oscillations. Study of dispersion properties of some elastic media. Reflection and absorption of waves. Determination of reflection and absorption coefficients. Determination of Young modulus in solids using a dynamical method. A. Harmonic analysis of periodic signals. Fast Fourier Transform (FFT). B. Introduction in Fourier analysis. Study of surface waves propagation in liquids.
F	RECOMMENDED READING FOR SEMINARS
	• A. Arya, Introduction to Classical Mechanics, 2nd ed., Pearson, 1997. • M. Alonso, E. J. Finn, Fundamental University Physics, vol. I, Mechanics, Addison-Wesley, 1967. • S. Popescu, Mechanical Oscillations, Elastic Waves and Acoustics, Ed. Matrix Rom, Bucureşti, 2003. • H. D. Young, R. A. Freedman, A. L. Ford, Sears and Zemansky's University Physics, with modern Physics, 14th ed., Pearson, 2016. • D. Luca, C. Stan, Practical works in Mechanics – Alexandru Ioan Cuza University of Iași Press, 1996.
G	EDUCATION STYLE
LEARNING AND TEACHING METHODS	Lecture, didactic explanation, heuristic conversation, video projection, problem solving method, case studies
ASSESSMENT METHODS	• Tests, written and oral examination • Weekly evaluation of homeworks and laboratory activity
LANGUAGE OF INSTRUCTION	English