GHENT UNIVERSITY

Course Specifications

Valid in the academic year 2023-2024

Physics: Waves, Optics and Thermodynamics (C003968)

Course size *(nominal values; actual values may depend on programme)*

Credits 5.0 **Study time 135 h**

Course offerings and teaching methods in academic year 2023-2024

A (semester 2)	Dutch	Gent	lecture
			seminar

Lecturers in academic year 2023-2024

Geiregat, Pieter	WE06	lecturer-in-charge

Offered in the following programmes in 2023-2024	**crdts**	**offering**
Bachelor of Science in Chemistry	5	A

Teaching languages

Dutch

Keywords

Vibrations, Waves, Optics, Thermodynamics, General Physics

Position of the course

This course is the second part of the general physics, the latter consisting of three parts: I. Mechanics, II. Waves and Optics and thermodynamics, III Electromagnetism and modern Physics.
The objective of this part is to build up the physics of mechanical vibrations and waves, based on the acquired knowledge of Newtonian mechanics. All this is supported by examples and problems. Further the student is made familiar with thermal physics, which starts from the concept of temperature and results in a complete logical development in the most important thermodynamic concepts, laws and equations.
The global basic physics also aims at stimulating the student to physical reasoning and problem-solving. This course makes use of skills in numerical modeling.

Contents

Oscillations and waves

- Oscillations : simple harmonic motion, damped and forced oscillations, resonance. Applications : mass on a spring, simple pendulum, physical and torsion pendulum.
- Waves : difference between oscillation and waves, longitudinal and transverse waves, wave velocity, energy transport. Mathematical representation of a traveling wave, the wave equation, superposition, reflection and transmission, interference. Standing waves, resonance, refraction and diffraction.
- Sound : speed of sound, pitch, intensity and Decibel scale, mathematical representation of longitudinal waves. Doppler effect, shock waves, sonic boom. Applications : sonar, ultrasound.

Thermal Physics

- Temperature : thermal equilibrium and the zeroth law, thermal expansion, thermometry, ideal-gas temperature scale.
- Kinetic theory of gases, molecular interpretation of temperature, Maxwell velocity distribution. Real gases and phase transitions, vapor pressure and humidity ; mean free path and diffusion.
- Heat and internal energy ; specific and latent heat. First law of thermodynamics : work in isothermal, isobar, adiabatic and isovolumetric processes ; molar specific heat, equipartition of energy. Heat transfer : convection, conduction,

radiation.
- Second law : heat engines and efficiency (steam engine, Otto and Diesel cycle), refrigerators.
- Reversibility and the Carnot cycle ; entropy (Clausius formulation and statistical interpretation) ; the third law.

Optics

- Reflection and refraction : the ray model of light, reflection and mirrors. Snell's law. Visible spectrum and dispersion. Total internal reflection. Refraction at a spherical surface.
- Lenses and optical instruments : lens equations. Applications : cameras, the eye and corrective lenses, microscopes and telescopes.
- Wave nature of light : Huygens' principle, interference and Young's double-slit experiment, thin films.
- Diffraction : diffraction in the double-slit experiment, limits of resolution, diffraction gratings and spectroscopy, X-ray diffraction. Polarization, Brewster's angle, LCD's, scattering of light in the atmosphere.

Initial competences

This course is based of the Newtonian mechanics of the first semester. Notions of advanced mathematics with respect to total differentials are recommended

Final competences

1 Show insight in the principles of mechanical vibrations and waves, be able to state them clearly, be able to point out and describe their applications.
2 Show insight in the principles of geometrical optics and optical phenomena as interference, diffraction and polarization, be able to state them clearly, be able to point out and describe their applications.
3 Show insight in the laws of thermodynamics and their impact, be able to state these clearly, be able to point out and describe applications.
4 Be able to point out the relation between the basic mechanics (dealt with in Physics I), and the physical principles studied in this course, be able to apply the principles and techniques of the introductory mechanics when dealing with vibrations, waves, optics, thermal physics.
5 Show insight in the mathematical derivation and/or formulation of the physics principles, be able to state them clearly and apply them in similar examples.
6 To have the ability to analyze simple physical problems and to translate them into a mathematical context in order to obtain a solution.
7 Show insight in orders of magnitude of physical quantities and be able to estimate them. To show a critical approach with regards to the acceptability of obtained results.

Conditions for credit contract

Access to this course unit via a credit contract is determined after successful competences assessment

Conditions for exam contract

This course unit cannot be taken via an exam contract

Teaching methods

Seminar, Lecture

Extra information on the teaching methods

When required by the COVID19 situation adapted education methods will be rolled out

Learning materials and price

D.C. Giancoli - Physics for Scientists and Engineers, Prentice Hall (2000) with access to Mastering Physics
Estimated cost: 150 EUR
Each student disposes of their own computer.

References

Zemansky and Dittman, Heat and Thermodynamics, Mc Graw-Hill, New York
(1981)-M. Alonso & E. Finn.
Fundamentals of physics"- D. Halliday, R. Resnick & J. Walker.

Course content-related study coaching

The knowledge and insight in applications can be tested via the interaction in the

workshops. Supplementary explanations can be obtained by e-mail, via Ufora, after each class, or by appointment.

Assessment moments

end-of-term assessment

Examination methods in case of periodic assessment during the first examination period

Written assessment with open-ended questions

Examination methods in case of periodic assessment during the second examination period

Written assessment with open-ended questions

Examination methods in case of permanent assessment

Possibilities of retake in case of permanent assessment

not applicable

Extra information on the examination methods

- Written examination to evaluate knowledge and insight
- Written examination with formularium: problems, to evaluate the ability to apply the knowledge.

Calculation of the examination mark

Theory : 12/20
Exercises : 8/20